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# Wilderness Zoning: Applying an Adapted Biosphere Reserve Model to Wilderness Areas

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## Abstract

America's wilderness areas represent pristine examples of untrammeled nature, invaluable biodiversity, and traditions of primitive outdoor recreation. These resources are vulnerable to mounting pressures, and as the human population continues to grow, anthropogenic impacts on wilderness areas continue to increase. Population growth, technology, and global climate change threaten to degrade wilderness quality. Traditional approaches to wilderness management, with their single directive approach, may be insufficient to protect against these threats (Carver, Tricker, & Landers, 2013; Cole & Hahn, 2006; Cole & Landres, 1996).

This paper offers a new approach to wilderness management based on the management of biosphere reserves. Research suggests zoned management may protect wilderness from degradation. Wilderness managers may consider applying this flexible zoning system, designating Core Zones, Scientific Research Zones, Cultural/Historical Zones, Recreation Zones, and Buffer Zones. A wilderness zoning policy could effectively protect wilderness from the challenges of anthropogenic change (Haas, Driver, Brown & Lucas, 1987).

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**Keywords:** wilderness, management, protected areas, recreation, outdoor recreation, natural resource management, recreation management, conservation, preservation

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America's wilderness areas represent the country's most pristine examples of untrammeled nature, invaluable biodiversity, and long-held traditions of primitive outdoor recreation. The network of wilderness areas that comprise the National Wilderness Preservation System (NWPS) is treasured for the unique qualities it offers: naturalness, solitude, and adventure. In a time of increasing development, technology, and civilization, wilderness areas offer an escape for recreationalists who seek a primitive outdoor experience. Beyond recreation, wilderness areas also offer benefits such as clean air and water, habitat for rare and endangered species, and pristine natural systems that can serve as a baseline for scientific research. But these treasured resources are falling victim to mounting pressures on wilderness areas, and as the human population continues to grow, anthropogenic impacts on wilderness areas continue to increase (Carver, Tricker, & Landers, 2013; Dvorak, Borrie, & Watson, 2011).

Wilderness managers are charged with the important task of maintaining pristine conditions within wilderness areas to ensure the land continues to meet the definition of wilderness as specified by the Wilderness Act of 1964 (the Wilderness Act) and each managing agency's policies (Carver et al., 2013). In many wilderness areas, management has taken on a uniform approach, treating all aspects of the area in the same manner, so long as they meet the minimum required conditions (Haas, Driver, Brown & Lucas, 1987). In other wilderness areas, managers employ different strategies in different areas based on the environmental impacts in those areas (Roggenbuck & Watson, 1993). However, present day wilderness areas in the United States are facing unprecedented and increasing threats to their naturalness and integrity, thus challenging current wilderness management paradigms (Dvorak, Borrie, & Watson, 2011).

Social, demographic, and biological forces are posing new threats to wilderness areas that the framers of the Wilderness Act could not have anticipated. Population growth and exurban sprawl have led human development to encroach upon the boundaries of wilderness areas to an unprecedented extent. Due to increasing demand, infrastructure for transportation and other services has spread into previously undeveloped areas, making it easier for distant populations to access remote wilderness areas. Technological advances – from lightweight gear to smart phone apps – have brought about widespread access to devices and information that encourage inexperienced recreationalists to explore wilderness areas. And although it is known that climate change poses a host of biological and ecological threats to wilderness areas, the scope of these threats remains somewhat unclear (Carver, Tricker, & Landers, 2013; Dvorak, Borrie, & Watson, 2011).

These social, demographic, and biological trends threaten to undermine the purpose of the Wilderness Act and the designation and management of pristine wilderness areas. The management approaches employed in the majority of wilderness areas may be inadequate to guard against these new and unforeseen threats. To ensure long-term protection for wilderness areas, a zoned management system with several layers of protection, similar to that employed in biosphere reserves, could offer the added security necessary to preserve pristine examples of wilderness in the United States.

**The Wilderness Act and Wilderness Management**

To more fully appreciate how a zoned management scheme would help protect wilderness areas, a brief review of the Wilderness Act and wilderness management is necessary. During the mid-1900s, social and economic change swept the nation, resulting in increasing development, sprawling suburbs, and expanding infrastructure (Marafiote, 2008). People became concerned that the rapid increase in development would lead to the destruction of all remaining wildlands in the country (Marafiote, 2008). In response to this concern,

Congress passed the Wilderness Act of 1964 to "assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas … leaving no lands designated for preservation and protection in their natural condition" (Marafiote, 2008; Wilderness Act of 1964, 2006, §1131). To achieve this goal, the Act created the NWPS, which serves as a network of designated areas "where the earth and community of life are untrammeled by man, where man himself is a visitor who does not remain" (Wilderness Act of 1964, 2006, §1131).

Since then, more than 750 wilderness areas have been designated, and each receives federal protection under the Wilderness Act. Each wilderness area is managed and protected by one of four federal agencies: the Bureau of Land Management (BLM), the National Park Service (NPS), United States Fish and Wildlife Service (FWS), or the United States Forest Service (USFS) (Carver et al., 2013). While inter-agency wilderness management strategies, such as "Keeping it Wild," do exist, it is primarily the task of the managing agencies and administrators to develop management strategies (Carver et al., 2013). Wilderness managers are required to comply with the legal provisions of the Act, but much is left to the discretion of agencies and managers in defining wilderness qualities and characteristics (Carver et al., 2013). The policy proposed herein would supplant the traditional uniform approach to wilderness management, replacing it with a dynamic, multi-faceted zoned management scheme and providing heightened protection for vulnerable ecosystems and natural resources.

In the context of wilderness management, the idea of zoned management is not a novel one. Shortly after the passage of the Wilderness Act, the USFS considered implementing a zoned management approach with three zones: pristine, median, and portal (Haas et al., 1987). Pristine zones were to protect the most pristine areas, median zones were of moderate purity, and portal zones were to be managed for the highest impacts and use levels (Haas et al., 1987). However, these designations provoked conflict and controversy, since they implied that heavy impacts and degradation were acceptable within certain parts of wilderness areas (Haas et al., 1987). The labels were quickly rescinded – along with the zoned management framework (Haas et al., 1987). Since then, managers in a handful of wilderness areas, including the Bob Marshall Wilderness in western Montana and the Maroon Bells-Snowmass Wilderness in central Colorado, have attempted to implement various zoning concepts to streamline management and use (Haas et al., 1987). Many wilderness managers, including USFS officials in particular, have adopted the Limits of Acceptable Change (LAC) framework for wilderness management (Roggenbuck & Watson, 1993). The LAC approach focuses on impacts and indicators that suggest the degree of naturalness each portion of a wilderness area reflects. In some cases, the land is even divided into zones, with a different management strategy applied to each area based upon the intensity of the impacts in that zone (Roggenbuck & Watson, 1993). The management plan recommended herein builds upon and enhances these examples of zoned management – and upon the example of biosphere management – to provide a cohesive and holistic wilderness management framework that effectively mitigates external influences on the integrity of wilderness areas.

Likewise, the idea of buffer zones is not new in the field of wilderness management. As early as the 1930s, scientists began to call for the implementation of buffer zones to address concerns that hunting and development outside the boundaries of protected areas had a disruptive effect on essential migratory patterns for wildlife (Shafer, 1999; Wright, Dixon, & Thompson, 1933). In 1932, the Ecological Society of America adopted a sanctuary plan that included buffer areas to protect large mammals against external influences, such as

poaching. Unfortunately, these early calls for buffer zones were largely ignored by the managing agencies (Shafer, 1999).

During the early 1980s, buffer zones were once again proposed as a solution to problems plaguing protected areas (Shafer, 1999). In 1980, NPS released a statement on the condition of America's parks, which highlighted the impacts of external influences on the integrity of parklands (Shafer, 1999). Legislation was proposed to address the problems raised in the statement, but once again the attempt to implement buffer zones was defeated. Local groups feared lands adjacent to parks or wilderness preserves would be subject to strict and economically crippling regulations if buffer zones were established, and hence they viewed buffer zones as a threat to their livelihoods (Shafer, 1999). Likewise, Congress was loath to take any actions to implement zones where landowners would be legally constrained by land use restrictions (Shafer, 1999). In the face of this reaction, federal agencies began to fear that the designation of new wilderness areas would be met with increased public resistance if such designation passed with hefty legal restrictions on land use. Eventually the term "buffer zone" became taboo as a matter of politics, leading agencies to drop the subject (Shafer, 1999).

As a practical matter, the function of buffer zones can be characterized in two distinct ways. From one perspective, the function of the buffer zone is to serve as an extended area of protection beyond the protected area boundaries, to buffer the inner area from outside influences (Martino, 2001). From another perspective, buffer zones act as an area where human civilization is buffered from the hazards of the wilderness area, offering neighboring populations protection from the natural dangers posed by living near the protected area, such as wildfires and wildlife (Martino, 2001). Landowners holding the former perspective may tend to have an unfavorable view of buffer zones, while landowners holding the latter perspective may tend to have a favorable view (Martino, 2001). Hence, further research is needed to provide insight into these two divergent perspectives, which may assist proponents of buffer zones in increasing public awareness of – and perhaps support for – the important role buffer zones could play around protected areas.

## A New Wave of Threats

Recent trends show the emergence of a new wave of threats to wilderness areas (Cole & Landres, 1996; Dvorak et al., 2011). Some scientists are increasingly concerned that the "steady erosion of biodiversity is leaving natural areas as islands in a matrix of encroaching anthropogenic change" (Grant & Samways, 2011, p. 772). Population growth, spreading technology, and global climate change are due to result in unprecedented pressures on wilderness areas. The traditional models of wilderness management may be insufficient to address the ever-increasing impacts of human activities within and without the boundaries of wilderness areas (Cole & Hahn, 2006). This paper proposes that these social, economic, and biological forces provide managers with the opportunity and the impetus to shift to zoned wilderness management. A closer examination of the problems posed by population growth, technology, and global climate change will clarify the need to consider new wilderness management strategies.

### Population Growth

The population of the United States is expected to increase by almost 50 percent from the year 2000 to 2050, and this growth will have a profound effect on the NWPS (Bowker et al., 2006). This dramatic increase in population will affect wilderness areas through three interrelated mechanisms: exurban sprawl, increasing infrastructure, and rising use demands.

First, population growth significantly contributes to the trend of exurban sprawl in the United States. Anthropogenic encroachment on protected areas is a well-documented phenomenon (Frentz, Farmer, Guldin, & Smith, 2004; Radeloff et

al., 2010). Research indicates that counties with federally designated wilderness areas have grown at a faster rate over the past several decades than counties without wilderness areas (Frentz et al., 2004). This growth is projected to continue, with one study estimating that 10 million housing units will be constructed within 50 kilometers of wilderness areas from the year 2000 to 2030 (Radeloff et al., 2010). Growing populations in the vicinity of wilderness areas have the potential to increase overall use of the resource, as proximity to a wilderness area is a strong factor when predicting the probability and frequency of visitation (Bowker et al., 2006). Encroachment can also lead to ecosystem and habitat fragmentation, difficulties with fire and natural disaster management, and increased pollution (Frentz et al., 2004). As more primitive areas adjacent to federally designated wilderness areas are converted for the sake of development, pressure will continue to increase on the supply of remaining wildlands in the United States (Bowker et al., 2006).

Second, population growth leads to expanding infrastructure to accommodate the demands of the people. In turn, the expansion of infrastructure leads to even more development in the suburbs and exurbs, as access has been greatly facilitated between exurban areas and metropolitan areas (Radeloff et al., 2010). Furthermore, as part of this infrastructure, secondary road networks become an increasingly common anthropogenic feature of the landscape (Leu, Hanser, & Knick, 2008). This growing network of roads also makes it easier for residents of distant metropolitan areas to access remote wilderness areas, often disrupting previously unreachable sites (Ewert & Shultis, 1999; United Nations Environmental Programme, n.d.). As transportation to wildlands becomes easier, increasing access has led to increasing use demands for wilderness areas, which in turn have led to increasing pressure on the resources of the NWPS (Ewert & Shultis, 1999).

Finally, population growth has been linked to increasing use demands for wilderness areas (Bowker et al., 2006). Estimates indicate there are approximately 16.3 million on-site visitor site-days per year in the NWPS (Bowker et al., 2006). Other estimates suggest visitation could be as high as 26.6 million visitor days per year (Bowker et al., 2005). Furthermore, annual wilderness recreation use is projected to increase over the next 40 years, with an estimated increase in wilderness visitor site-days of about 21 percent from 2002 to 2050 (Bowker et al., 2006). Hence, wilderness managers face the task of preparing for the unprecedented impacts these recreation use trends will have on wilderness areas.

**Technology and Wilderness**

The relationship between wilderness recreation and the use of technology is often a paradoxical one: while many wilderness users seek to escape civilization and to experience a primitive, simple way of life, they increasingly depend on various forms of technology to enjoy their wilderness experience (Myncite, Casper, & Cole, 2009; Shultis, 2000). Technology in wilderness can range from ultra-light gear to personal locator beacons to smart phones with environmental education apps. Wilderness areas typically post information and maps on the Internet to help users plan their visits, and in today's age of ubiquitous Internet and social media resources recreationalists can even find information about wilderness on Facebook, Instagram, Pinterest, YouTube, and other social networks.

Technology may influence users' perceptions and expectations of wilderness. For example, there is a perception by visitors that technology (especially in the form of cell phones and personal locator beacons) makes wilderness recreation safer (Pope & Martin, 2011). This perception could lead inexperienced individuals who may not have previously chosen to visit wilderness areas to venture into the backcountry of the NWPS (Pope & Martin, 2011). Hence, technology creates a false

safety net that may lead new users to visit remote wilderness areas. This trend could lead to more (necessary and unnecessary) rescue calls (Pope & Martin, 2011), while also contributing to higher overall levels of anthropogenic impacts such as soil erosion, air pollution, and reduced water quality in some wilderness areas (Ewert & Shultis, 1999). These anthropogenic impacts on the land can be even more pronounced when inexperienced users fail to follow proper wilderness protocols, such as the Leave No Trace principles. For example, recreational trail use has been linked to the spread of non-native species in wilderness areas, a problem that is especially acute when users are unfamiliar with practices and procedures that minimize the risk of exotic species introduction (Dickens, Gerhardt, & Collinge, 2005). Hence, wilderness managers may wish to address these issues as technology continues to become more intertwined with the wilderness experience.

**Wilderness and Global Climate Change**

Another threat to the integrity and purity of wilderness areas is global climate change. Climate change has the potential to dramatically alter the fundamental characteristics of the habitats and ecosystems of wilderness (Smith & Travis, 2010). Species distributions may shift across the landscape due to changes in temperature and precipitation patterns, sometimes even resulting in a biome change (Frelich & Reich, 2009; Smith & Travis, 2010). The spread of invasive species is expected to exacerbate the ecological impacts caused by warming temperatures (Frelich & Reich, 2009). Climate change may also lead to increased fire risk, pests, and disease (Smith & Travis, 2010). Unfortunately, wilderness managers face a great deal of uncertainty when it comes to predicting the specific effects climate change may have on individual wilderness areas (Smith & Travis, 2010). The effects of climate change can vary widely on the regional and local levels, and wilderness managers face the challenge of preparing for adaptive measures (Smith & Travis, 2010). While research on adaptation strategies has increased over the past several years, there are still wide gaps in the literature, leaving managers with few practical strategies for addressing the impacts of global climate change (Heller & Zavaleta, 2009).

Despite these uncertainties, global climate change may be the most widespread and continuous impact on wilderness (Cole & Landres, 1996). There is a growing consensus that a "broad, landscape-ecological approach" will be necessary to address the impacts of climate change on wilderness areas (Batisse, 1997, p. 14). Researchers have suggested a pluralistic approach is required when formulating adaptation strategies for global climate change and insist these strategies must extend beyond the boundaries of protected areas (Hobbs et al., 2010). Wilderness managers should therefore consider the adoption of practical strategies for adapting to these long-term potential changes, and the zoning scheme proposed in this paper presents a feasible approach for managers to consider.

**Biosphere Reserves as a Model**

In 1968, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) launched the Man and the Biosphere (MAB) Programme to address the issues of conservation and sustainable development on a worldwide scale (Batisse, 1982). Over the ensuing decades, the MAB Programme established a network of worldwide biosphere reserves, which are managed specifically for conservation, sustainable development, and scientific monitoring and research (Batisse, 1997). There are currently 631 biosphere reserves located in 119 countries around the world (UNESCO, n.d.).

The MAB Programme employs a three-tiered zoning structure to protect biosphere reserves, including core areas, buffer zones, and transition areas, as illustrated in Figure 1 (Batisse, 1997). Core areas are stringently protected to preserve biodiversity and to monitor pristine ecosystems (Batisse, 1997). Buffer zones surround the core

areas, providing opportunities for recreation, ecotourism, scientific research, cultural activities, and environmental education (Batisse, 1997). Buffer zones protect the core areas against undue interference and are limited to activities consistent with the conservation objectives of the core zones (Batisse, 1997). Finally, transition areas surround the buffer zones. Transition areas may stretch into residential and agricultural communities, and their purpose is to promote sustainable development and wise resource use so that neighboring communities can function in a way that is compatible with the protection of local biodiversity (Batisse, 1997).

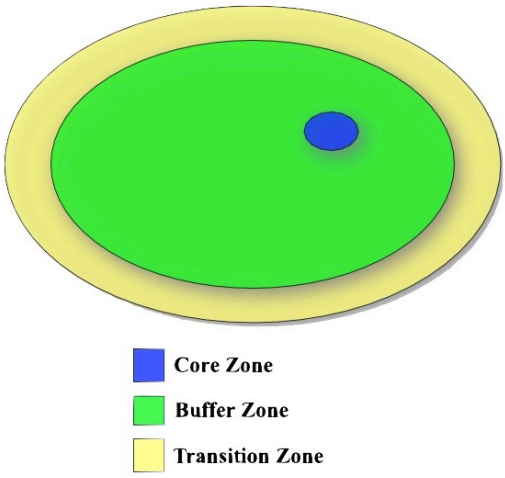


*Figure 1.* Biosphere reserve zoning. Biosphere reserves employ a three-tiered zoning structure to ensure that areas of exceptional biodiversity are protected from encroaching development.

Researchers have measured the effectiveness of the biosphere reserve zoned management scheme based on various biological criteria, and findings indicate the cushioning provided by the outer zones helps protect certain indicator species within the core zones (Grant & Samways, 2011). For example, limited human access has been linked to increased ungulate occurrence in core zones of biosphere reserves, suggesting a core zone can be an effective management tool for protecting wildlife (Licona, McCleery, Collier, Brightsmith, & Lopez, 2011). In another study, researchers found that the presence of buffer and transitional zones was instrumental in protecting threatened and endemic dragonfly populations located in a biosphere core zone from the threats of invasive species (Grant & Samways, 2011). Overall, the success of the biosphere zones suggested by current research indicates that a similar model could help to protect wilderness areas in the United States.

**Wilderness Zoning**

Many wilderness managers today employ a uniform approach with a single management directive: to keep all wilderness areas at or above the levels of undisturbed purity required by the Wilderness Act (Haas et al., 1987). Critics have argued this single-threshold approach allows some areas of exceptionally pristine quality to decline to minimum statutory conditions (Haas et al., 1987). The result of this approach will likely be a race to the bottom, where biodiversity hotspots and exceptionally pristine examples of wilderness are lost. As the pressures on wilderness areas continue to increase, the shortcomings of the single management approach will only be magnified. To address the new threats facing wilderness areas, policymakers may wish to consider a new management policy – one that will protect pristine areas and prevent a decline to minimum wilderness standards across the board. The management plan described herein would create a flexible zoning model that would mitigate the impacts of threats to the most pristine ecosystems, providing better long-term protection for the country's most valuable ecological resources.

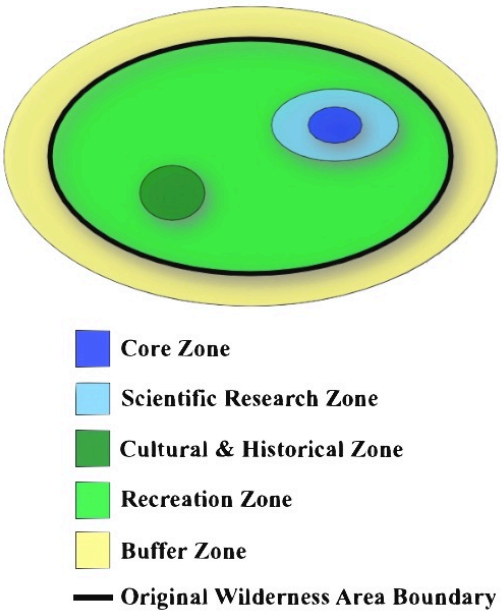


*Figure 2*. Wilderness zoning. The proposed policy recommends a five-tiered zoning system for wilderness areas. This model is a flexible, dynamic zoning system that can be applied and adapted to meet the unique needs of each wilderness area.

The proposed policy involves the establishment of five distinct types of zones, as shown in Figure 2. First, managers would designate one or several Core Zones, which would be the keystone of the new zoning paradigm. Here, all human interference would be prohibited to protect the integrity of the land. These zones would serve to protect areas identified as hosting significant biodiversity as well as areas that provide the most pristine examples of wilderness. Core Zones would also serve to provide ecosystem services – such as clean air and water – and critical habitat for threatened and endangered species.

Next, a Scientific Research Zone would surround the Core Zone(s). Here, researchers would be permitted to conduct nondestructive research and monitoring of various environmental conditions and biological indicators. Educators would also have opportunities to conduct environmental educational programming within these zones. There would be opportunities for research and education in these protected zones. However, agencies may need to issue permits to scientific and educational groups seeking to take advantage of these opportunities. This zone would be more restrictive than the Recreation Zone, but it would aid in advancing scientific knowledge of the natural world. The relative lack of anthropogenic interference in Scientific Research Zones and Core Zones would help to minimize impacts such as invasive species introduction, wildlife disturbance, vegetation trampling, and soil erosion.

In those wilderness areas containing sites of cultural and historical significance, managers would establish Cultural/Historical Zones. These zones would provide managers with an opportunity to protect and improve these unique resources. Projects and restrictions would be specifically tailored to each distinct site. The integrity of these sites and their cultural, historical, and natural context could be better preserved through zoned management that considers the special challenges and opportunities posed by these unique resources.

Beyond these zones, managers would establish a large Recreation Zone that would occupy the remainder of the designated wilderness area. In this zone, all users would be able to enjoy the benefits of the wilderness area, generally under the same limitations that presently exist for wilderness recreation. Managers would prioritize the provision of opportunities to experience nature, solitude, and adventure in these zones. Managers could also implement strategies for minimizing impacts on the land in these areas by encouraging environmentally responsible recreational practices.

Finally, managers would establish a Buffer Zone[1], which would surround the wilderness area to mitigate the impact of outside influences. Depending on the position of the wilderness area, a surrounding national forest or national park might serve as an ample Buffer Zone. In other cases, the Buffer Zone could impinge on privately owned adjacent lands.

Managers would work together with local communities to establish voluntary, cooperative arrangements promoting sustainable development, conservation practices, and other measures aimed at preserving the integrity of the wilderness area. Additionally, non-governmental organizations could work together with wilderness managers to help purchase Buffer Zones and conservation easements around certain wilderness areas. Education to increase public awareness of the benefits of a Buffer Zone would strengthen managers' chances for successful implementation of these important transitional areas.

Under this policy, each zone would be managed with specific attention to its designated use and its ecological context. Management plans and objectives would be tailored to match the unique geographic, biological, and historical features of each zone. This new system would protect biodiversity, ensure pristine areas remain as untrammeled as possible, establish concrete management objectives suited to each zone, provide opportunities for research, scientific discovery, and environmental education, and ensure users will be able to enjoy authentic wilderness experiences for generations to come. And most importantly, this zoning paradigm would serve to help proactively address the threats posed by population growth, technology, and global climate change.

This zoned management paradigm would be applied with great flexibility, recognizing the unique features and challenges each wilderness area holds and incorporating the special needs of each area. As mentioned above, some wilderness areas have natural existing buffers, as they border BLM, FWS, NPS, or USFS lands, while others do not. Some wilderness areas are smaller with highly concentrated use throughout the area, while others are large with impacts dispersed across the land. The five-tiered zoning structure is meant to be flexibly applied to wilderness areas so that managers can tailor the model to meet the individual needs of each protected area[2]. Zoned management plans for individual wilderness areas could be developed in consultation with experts, agency officials, and local stakeholders (Zhang et al., 2013). Researchers have even designed participatory geographic information system (PGIS) guidelines for establishing management zones in protected areas, incorporating local knowledge, stakeholder desires, and expert opinions into the zoning process (Zhang et al., 2013).

Building upon this policy proposal, zoned wilderness areas surrounded by sufficient buffer zones could also form a larger holistic framework of protected lands. Contiguous buffer zones could form links and corridors for wildlife, vegetation, and other natural resources. Much like the idea of mega-reserves in Africa, buffer zones could weave together various protected lands, with "individual conservation units . . . linked together into a large-scale regional corridor system" (Laurance, 2005, p. 1). The early belief that isolated islands of protected lands would preserve precious natural resources has been rejected in favor of a broader connected-landscape view (Heller & Zavaleta, 2009; Radeloff et al., 2010; Wade, Theobald, & Laituri, 2011). The future of many ecosystems depends upon holistic efforts that employ a regional or even national frame of reference. The zoning paradigm proposed herein may be a first step toward such a holistic movement.

**Challenges and Opportunities**

While the proposed zoning scheme provides many benefits and opportunities for mangers, it would also face some challenges. First, recreational users may object to the new policy because of use restrictions. Users may dislike the idea of being excluded from the Scientific Research and Core Zones, but managers could assure these users that Recreation Zones would be very large, occupying the vast majority of wilderness areas as they currently exist. Users should also take note that managers would prioritize management for recreational use in Recreation Zones, with plans

aimed at providing quality wilderness opportunities for visitors who are seeking naturalness and solitude.

In addition, local communities may object to the idea of the Buffer Zone, as they fear the imposition of mandatory restrictions on development and land use. But managers could incorporate a variety of positive approaches to this issue rather than resorting to strict regulatory measures. For instance, managers could promote the use of conservation easements, tax incentives, education, and stewardship to help establish Buffer Zones. By educating the local community about the benefits of a Buffer Zone and instilling a sense of stewardship in the public, voluntary compliance with sustainable development and sound environmental practices may be possible. Financial incentives such as conservation easements and tax breaks could also be enacted at the local, state, or federal level to provide support for wise land use.

Finally, managers may face challenges in implementing a zoned management scheme at a time when federal resources and funding are limited. However, a zoning paradigm actually allows managers to administer projects and funds more effectively than traditional management strategies. Zoning allows managers to prioritize more acute needs in certain parts of wilderness areas. By dividing wilderness areas into clear zones, each with unique goals and needs, managers may more effectively and efficiently allocate funds to projects, trimming their budgets and preventing wasted funds.

## Conclusion

Population growth, increasing technology, and the threat of global climate change are part of a wave of unprecedented threats to these irreplaceable natural resources. The gravity of these threats calls for the development of a practical plan of action to aid wilderness managers in protecting these fragile ecosystems from degradation and even destruction.

Current management paradigms may be insufficient to protect wilderness areas from these growing threats. A broad, landscape-based strategy designed to suit each unique wilderness area may help wilderness managers to guard against the degradation of these resources. The zoned management scheme proposed herein could provide the heightened level of protection needed to preserve the most pristine examples of wilderness. Core Zones would protect the most pristine and vulnerable natural resources in the NWPS. Scientific Research Zones would provide researchers and educators with groundbreaking opportunities for inquiry and education. Cultural/Historical Zones could protect the unique cultural and historical resources held within the NWPS. Recreation Zones would allow managers to continue to provide primitive recreation experiences to those who seek them, and Buffer Zones could bridge the divide between wilderness and civilization, helping communities to embrace sustainable practices that protect neighboring wildlands.

Further research is needed on the effectiveness of wilderness zoning in those wilderness areas where zoned management is already in effect, such as the Bob Marshall Wilderness and the Maroon Bells-Snowmass Wilderness. Managers in these areas may be able to provide unique insight into the issues raised in this paper. Further research about the attitudes and opinions of wilderness users would also help managers to craft effective policies in implementing the new wilderness zoning system.

Wilderness represents the last of the nation's natural, undeveloped lands. While wilderness is easy to destroy, it is nearly impossible to recreate. A proactive strategy may prove more effective than reactive measures when it comes to the protection of these unique ecosystems. In light of recent trends and growing threats, managers and policymakers may wish to consider taking strategic action now by implementing zoned wilderness management to preserve the tradition and integrity of wilderness areas for generations to come.

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**Footnotes**

[1] Legislation designating wilderness areas is often accompanied by language specifying that Congress does not intend to designate a legally protected buffer zone surrounding the wilderness area. These legal disclaimers do not, however, preclude the use of cooperative, voluntary measures by wilderness managers or managing agencies to effectuate a buffer zone as described in this paper, nor do they preclude the future enactment of buffer zone legislation or incentives.

[2] It is important to note the management issues identified herein are likely most applicable to wilderness in the continental United States, particularly with regard to wilderness in the eastern half of the country, where sprawling development is a pervasive issue.