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INTEGRATING CONSERVATION MANAGEMENT, SPECIES PROTECTION, AND ECONOMIC VIABILITY INTO SUSTAINABLE LAND USE PRACTICES FOR THE CERULEAN WARBLER (*SETOPHAGA CERULEA*) IN THE APPALACHIAN AND NORTHERN ANDES MOUNTAINS

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Resumen. – Prácticas sostenibles de uso de tierra para las Reinitas Cerúleas. – La región montañosa de los Apalaches en Norteamérica sostiene cerca del 80% de la población reproductiva global de la Reinita Cerúlea (*Setophaga cerulea*), mientras que los Andes del norte al parecer albergan a la mayor parte de la población durante la época no reproductiva. Sin embargo, los paisajes forestales de los que depende la Reinita Cerúlea en ambas regiones, son objeto de múltiples presiones antropogénicas, como la extracción de recursos naturales o varias formas de agricultura, siendo los productos de estos dos tipos de presión importantes a nivel nacional y mundial. La viabilidad a largo plazo de la Reinita Cerúlea depende de asociaciones de conservación con numerosas industrias, cada una de ellas con objetivos y prácticas diferentes para el uso de tierra. Por lo tanto es esencial que los científicos de la conservación y las agencias de manejo de tierra, trabajen con los actores clave para desarrollar soluciones de conservación proactivas que se puedan integrar a las operaciones de la industria con un impacto mínimo para los beneficios económicos, requisitos de regulación, normas de seguridad y eficiencia en general. Trabajando en conjunto, los profesionales de la conservación y las varias industrias en ambas regiones, pueden lograr progresos enormes hacia la conservación y restauración de paisajes forestales, que puedan mantener poblaciones de la Reinita Cerúlea y que a la vez puedan sostener las economías locales en el futuro.

Abstract. – The Appalachian Mountain region in North America supports nearly 80% of the global breeding population of Cerulean Warbler (*Setophaga cerulea*), and the northern Andes Mountains appear to support the majority of the population during the nonbreeding season. However, the forested landscapes that Cerulean Warbler relies upon in both regions are subject to numerous anthropogenic stressors from the extraction of natural resources or various forms of agriculture, with products from both of these stressors being globally

and domestically important. The long-term viability of Cerulean Warbler relies upon conservation partnerships with numerous industries, each with different land management objectives and practices. Therefore, it is essential that conservation scientists and land management agencies work with key stakeholders to develop proactive conservation solutions that can be integrated into industry operations with minimal impact to industry profits, regulatory requirements, safety standards, and overall efficiency. Working in partnership, conservation professionals and the various industries in both regions can make tremendous progress in conserving and restoring forested landscapes that can sustain Cerulean Warbler populations and support local economies into the future.

Key words: Cerulean Warbler, *Setophaga cerulea*, Appalachian Mountains, northern Andes Mountains, coal, forest products, coffee, conservation partnerships.

INTRODUCTION

Over the last 15 years or so, the ornithological community has increased its focus on full life cycle conservation of Nearctic-Neotropical migrants, recog-nizing that breeding, migration, and nonbreeding seasons each play vital and inter-connected roles in both individual annual survival and reproductive success and population long-term viability. Because full cycle conservation of Nearctic-Neotropical migrants is such a complex issue and is international in scope, numerous partnerships have developed in order to (1) gain a better understanding of limiting factors for long-distance migrants throughout their annual life cycles and (2) identify critical actions needed to conserve species of concern. One such partnership, the Cerulean Warbler (*Setophaga cerulea*) Technical Group (CWTG), has focused more than a decade of coordinated time, intelligence, and resources on identifying critical limiting factors and strategic conservation actions for the species and its associates on the breeding and nonbreeding (wintering) grounds and along migratory pathways.

Cerulean Warbler is a Nearctic-Neotropical migrant songbird that has experienced a rapid and long-term population decline, primarily due to habitat fragmentation from human activity on its breeding and nonbreeding grounds. The diverse hardwood forests of the Appalachian Mountain region in North America support nearly 80% of the global breeding population of Cerulean Warbler (Blancher *et al.* 2007). During North America's winter, the species primarily inhabits forests between 500 – 1500 m elevation in the northern Andes Mountains (Hamel 2000, Fundación ProAves *et al.* 2010). The two regions share several basic characteristics: (1) high biodiversity of plants and animals, (2) rugged terrain that is mostly forested yet highly fragmented, (3) abundant natural resources (forests, water, minerals, fossil fuels), and (4) rural communities that rely on extraction or growth of globally important products (e.g., coffee, coal, forest products, natural gas). Therefore, the long-term viability of Cerulean Warbler will require conservation partnerships with local communities and numerous industries and the development of sustainable yet economically viable business practices (e.g., Cerulean Warbler-friendly certifications or best management practices) and conservation strategies (Sánchez-Clavijo *et al.* 2008).

It is essential that conservation scientists and land management agencies work with key stakeholders to develop proactive conservation solutions that can be integrated into industry operations with minimal impact to industry profits, regulatory requirements, safety standards, and overall efficiency. Recent efforts and future opportunities to engage the coal and coffee industries in North and South America, respectively, provide examples.

APPALACHIAN MOUNTAINS BREEDING RANGE AND COAL

The highest densities of breeding Cerulean Warbler (West Virginia, southeast Ohio, eastern Kentucky, and northeastern Tennessee) share a high degree of overlap with the Appalachian Coal Fields, an area that contains underlying seams of coal awaiting extraction, thousands of underground mines, and active or idle surface mines that range in size from a few hectares to over 1,000 hectares. The Surface Mining Control and Reclamation Act (SMCRA) of 1977 regulates the environmental effects of coal mining and the reclamation of impacted lands. Until recently, regulating agencies and companies responsible for reclamation focused on soil stability and control of water runoff and sedimentation. The practices employed since the passage of SMCRA have led to severely compacted substrates on over 400,000 ha of mined lands in the Appalachian region, most of which are primarily non-native grasses (cool season), or a combination of non-native grasses, shrubs, and trees. Most of these reclaimed areas are incapable of supporting the diverse hardwood forests that were present prior to mining activities. However, a broad constituency interested in reforestation of coal-mined lands began to develop in the mid-1990s, culminating in the formation of the Appalachian Regional Reforestation Initiative (ARRI) in 2004. The ARRI is a coalition of groups (including citizens, the coal industry, and government agencies) dedicated to restoring forests on coal-mined lands using the science-based Forestry Reclamation Approach (FRA; Burger *et al.* 2005, 2011)—not only on current and future surface mines, but also on the estimated 300,000 ha of "legacy" mines reclaimed since the passage of SMCRA that still are not supporting native hardwood forests. The goals of ARRI for mine reclamation and restoration are to (1) plant more high-value and diverse hardwood trees, (2) increase the survival rates and growth of planted trees, and (3) expedite the establishment of forest habitat through natural succession. Since the start of ARRI in 2004, approximately 70 million trees have been planted and approximately 41,683 ha restored to forests on newly mined land, and approximately 644,000 trees on about 372 ha of "legacy" surface mines. Additionally, implementation of the FRA varies among the coal-producing states in the Appalachian Mountains, with three states reporting between 90–100% of their mining permits require a forestry post-mining land use using the FRA methodology, whereas that percentage is much lower in other states. Given the overlap of past and current mining activities with core breeding habitat for Cerulean Warblers, the momentum gathering around mineland reforestation, and the additional reforestation efforts needed within core breeding habitat for Cerulean Warbler, members of the CWTG and ARRI initiated a partnership in 2005 to promote and target reforestation of coal-mined lands (current, future, and legacy mines) to benefit Cerulean Warbler and other forest-dependent wildlife in the Appalachian Mountains.

A migratory bird habitat conservation partnership for the Appalachian region, the Appalachian Mountains Joint Venture (AMJV) was formed in 2007 (and formally approved by U.S. Fish and Wildlife Service in 2008) and joined both the CWTG and ARRI partnerships. The AMJV and CWTG began to develop products to help target reforestation projects and inform the coal industry about why such efforts were needed. For example, Shumar (2009) created a predictive map of Cerulean Warbler abundance to help ARRI prioritize legacy mine reforestation projects with the highest potential for improving habitat for the species. The Shumar (2009) Bayesian hierarchical model for the Appalachian Mountains Bird Conservation Region used count data from the North American Breeding Bird Survey (http://www.pwrc.usgs.gov/bbs/) and a suite of environmental covariates temporally matched to the 2001 National Landcover Database. This map was then used to identify and prioritize previously

mined lands for reforestation in a portion of the Cerulean Warbler's core breeding range (Wood *et al.* 2010; Fig. 1). The AMJV partnership also recently completed a science-based, expert-led process to identify focal areas on-the-ground conservation efforts for Cerulean Warbler within the Appalachian region, and members of the CWTG and AMJV are developing a "Best Management Practices" document for forest management activities to benefit the species. Although relatively new, the three partnerships (ARRI, CWTG, and AMJV) are making tremendous progress toward building a future landscape that can sustain both Cerulean Warbler populations and local economies on Appalachian breeding grounds of Cerulean Warbler.

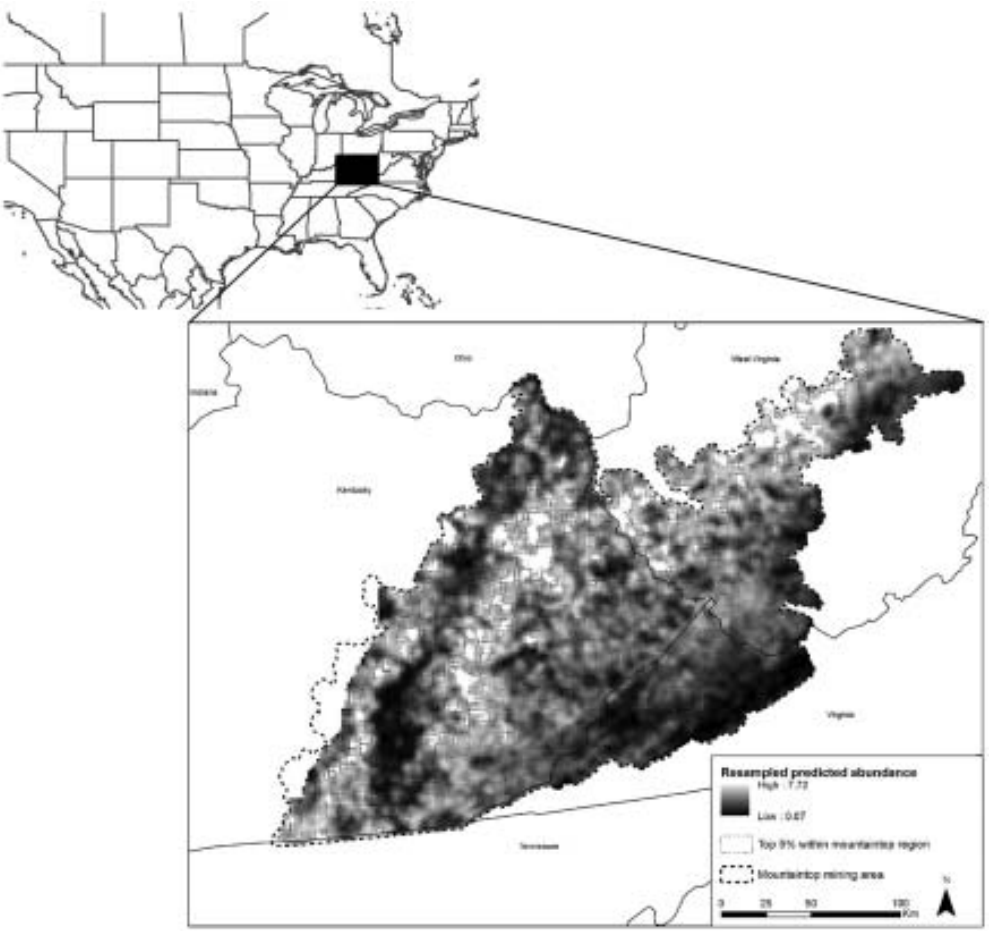

FIG. 1. Predicted Cerulean Warbler abundance was used to identify and prioritize previously mined lands for reforestation in a portion of the core breeding range (from Wood *et al.* 2010), where coal mining by mountaintop removal currently is being practiced. Areas shown in white (exception: the area in white along the western boundary of the mountaintop mining area is a modeling anomaly) have the highest predicted abundance of Cerulean Warbler. Mined lands within these areas were identified as the highest priorities for reforestation based on their proximity to areas of high predicted abundance of Cerulean Warbler.

NORTHERN ANDES NONBREEDING RANGE AND COFFEE

Recent research and surveys conducted by various CWTG partners throughout the winter range of Cerulean Warbler have indicated a strong presence of the species in the coffee-growing region of the Northern Andes Mountains, with higher densities and more detections of Cerulean Warblers in shade coffee plantations than in primary forest (Bakermans *et al.* 2009). Cerulean Warblers that regularly foraged in shade coffee plantations had high monthly survival rates, gained weight through the winter, and showed fidelity to particular sites within and between winters (Botero *et al.* 2008, Bakermans *et al.* 2009, Sánchez-Clavijo *et al.* 2010). However, for various reasons, conversion to shade coffee is not practical in all of the coffee growing regions in the Northern Andes, and implementing national-level conservation initiatives presents numerous challenges. For example, there are over 500,000 families that grow and sell coffee commercially in Colombia, and nearly 95% of those family farms are less than 5 ha each (unpublished data, Federación Nacional de Cafeteros de Colombia 2007). Therefore, any coffee-related conservation initiative for Cerulean Warbler must consider at least four general principles to be effective: (1) planning and implementation should be conducted at a regional or possibly national scale, but the initiative must provide tangible benefits to local communities and individual landowners; (2) conservation strategies should be science-based, targeted at productive wintering areas, and developed for both shade and sun coffee regions (i.e., where shade coffee is not a viable option, what other strategies exist to conserve Cerulean Warbler habitat?); (3) local communities should be engaged in the conservation of fragile ecosystems linked to important environmental services, biodiversity, and watershed health; and (4) consumers of coffee worldwide must be educated on the link between coffee, conservation, and sustainable ecosystem function.

As an example, over the last decade, members of El Grupo Cerúleo have gathered data in Colombia (and other countries in the Northern Andes) to guide on-the-ground conservation efforts. Based on data gathered, American Bird Conservancy (ABC) and Fundación ProAves began conserving land and working with local communities in central Colombia, targeting an area that supports a high density of Cerulean Warbler in primary forest and shade-coffee plantations. In 2006 and 2007, ABC and Fundación ProAves purchased a total of 1,371 ha (which included a coffee plantation) to establish the Cerulean Warbler Reserve. ABC and Fundación ProAves also worked with local communities over the next several years to educate and engage them in conservation efforts (Skolnik *et al.* 2012). In order to conserve Cerulean Warbler nonbreeding habitat, more conservation efforts such as these must be developed, and must be guided by the latest science, engage broad conservation partnerships, and incorporate local communities into planning efforts for sustainable economies and environments.

CONCLUSION

The long-term decline of Cerulean Warbler (and many other Nearctic-Neotropical migrants) and a growing body of research on limiting factors both point to the critical importance of a full life cycle approach to conservation. Members of the CWTG and AMJV partnerships currently have sufficient information to strategically and effectively conserve and improve habitat for Cerulean Warbler, to engage new partners, and to practice adaptive conservation as we learn more about the species. As we move forward into the implementation phase of Cerulean Warbler conservation, we must develop conservation strategies for specific seasons, regions, and focal areas to ensure that we address limiting factors at multiple spatial and temporal scales. Given the two major regions where our work will focus, our conservation strategies must ensure economic

viability and sustainability of natural resources, and the industries and local communities must be able to see tangible benefits from our efforts. Most importantly, however, we must continue to work through, and further expand, our partnerships; only through collaboration will our conservation goals be achieved at local, state, national, and international scales.

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