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Abstract

Migratory bird populations in the United States are estimated at a minimum of 10 billion individuals, with fall breeding populations of up to 20 billion, though exact numbers are difficult to ascertain (USFWS). A proportion of these are neotropical migratory birds that live in all kinds of habitats throughout the United States and travel between summer breeding grounds in Canada and the United States and wintering habitat in Mexico, Central and South America or the islands of the Caribbean. The state of Maryland comprises a surprising array of bird habitats for such a small state and supports a variety of threatened and vulnerable species such as the Black Rail, Saltmarsh Sharp-tailed Sparrow, Piping Plover and Tundra Swan (Audubon 2012). Numerous neotropical migrants breed in Maryland. Migratory birds have seen declines and changes to breeding and stop-over habitats across North America. Destruction of rainforest in wintering habitat throughout Central and South America is another important factor in the decrease in U.S. nesting species. Bird mortality is also incurred due to collisions with artificial objects such as tall buildings (and other tall structures lit up at night), power lines, and windmills, human-introduced contaminants, and predation from non-native species, such as housecats (USFWS 2010 p.18). Though the hazards and threats to migratory birds are extreme and numerous, there are many ways that individuals and organizations can become involved. However, without a concerted effort to minimize habitat loss and fragmentation and the impacts of climate change, bird populations will face insurmountable losses.

Overview of Migratory Bird Conservation with a Focus on Maryland Species

Introduction

Bird populations worldwide are declining due to a variety of human impacts. Pesticide contamination, hunting, predation by feral and house cats, strikes of communications towers, and window collisions are responsible for bird mortality on the order of billions per year. The largest impacts on bird populations, however, are habitat loss and fragmentation, coupled with the effects of global warming (Audubon 2012 -1). For migratory birds, these impacts are likely to be more severe given their need for quality habitat for breeding, stopover, wintering and spring and fall migrations. For neotropical migrants (those that overwinter in the tropics), decreases in habitat in Northern ranges will decrease the breeding population of birds, while a decrease in southern habitat (including Central and South America) reduces their overwintering feeding grounds.

Numerous neotropical birds breed in several unique habitats in Maryland such as hickory-oak forests and coastal salt marshes. Protection for these and other migratory birds requires education and research across their range, and commitment amongst governments, NGOs and other conservation groups with differing cultural perspectives and value systems, economic need, educational systems and languages. However, the beauty and majesty of birds, and the awe-inspiring life cycle of migratory birds in particular can be a binding force for on the ground conservation efforts. For developing countries throughout the tropics, to coastal areas on the Eastern shore (of the Chesapeake Bay) of Maryland, bird-watching and ecotourism generate economic reward for those who maintain, or in some cases augment, habitat for birds. For example, in the Dominican Republic, research on migratory birds has fostered an ecotourism industry catering to high-end bird watching (Latta and Faaborg 2009). In Maryland, individuals engaged in bird watching and ecotourism bring support to the economy of the Eastern shore (Shorebird Habitat Program 2012).

The goal of this paper is to increase knowledge of migratory birds in general, and provide more specific information regarding those birds that winter in the neotropics and return to the mid-Atlantic, specifically Maryland, to breed. Threats encountered by migratory birds, from loss of habitat to predation will be discussed. Programs working to reduce the impact of these threats are presented. Additional conservation solutions are presented, from shade grown coffee

production to school bird habitat projects. Finally, programs that focus on uniting communities, cultures and countries in conservation efforts are presented.

Migratory Bird Overview

Migratory bird populations in the United States are estimated at a minimum of 10 billion individuals, with fall breeding populations of up to 20 billion, though exact numbers are difficult to ascertain (USFWS). According to the Fish and Wildlife Service, 836 species of birds are protected under the Migratory Bird Treaty Act.[1] Of these, 78 species are listed as endangered and 14 are threatened in the US, with an additional 144 being listed as Birds of Conservation Concern 2001[2]. The actual number of birds in danger is probably much higher due to a lack of population data to evaluate the status of another 1/3 of bird species (USFWS).

Migratory birds generally winter in warmer areas and have their summer breeding grounds in the north. Neotropical migratory birds live in all kinds of habitats throughout the United States and travel between summer breeding grounds in Canada and the United States and wintering habitat in Mexico, Central and South America or the islands of the Caribbean. Another definition limits neotropical migratory birds to Western Hemisphere species in which the majority of individuals breed north of the Tropic of Cancer (latitude 23 degrees north of the equator) and winter south of it. By these definitions there are between 200-250 species of neotropical migratory birds, made up mostly of songbirds such as warblers, thrushes, tanagers and vireos but also including many shorebirds (such as plovers), raptors (such as hawks) and waterfowl (such as teal) (USFWS, Nowak 2005, Deinlein 2012).

The state of Maryland comprises a surprising array of bird habitats for such a small state, including floodplain forest, northern coniferous forest, meadow grassland, boreal bog, brackish marshes, sandy barrier islands and others (Audubon 2012 -2). These habitats support a variety of threatened and vulnerable species such as the Black Rail, Saltmarsh Sharp-tailed Sparrow, Piping Plover and Tundra Swan. The Audubon Society's Important Bird Areas Program in Maryland and DC publicly recognizes 40 Important Bird Areas (IBA) in Maryland. The largest acreage is

[1] For a full list of migratory birds protected under the Migratory Bird Treaty Act, see http://www.fws.gov/migratorybirds/RegulationsPolicies/mbta/mbtandx.html

[2] The 1988 amendment to the Fish and Wildlife Conservation Act mandates the U.S. Fish and Wildlife Service to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973." *Birds of Conservation Concern 2008* (*BCC 2008*) is the most recent effort to carry out this mandate.

in the Chesapeake Bay region because the "extensive tidal wetlands, floodplain marshes and forests, and open waters support continentally and globally significant populations of waterfowl, marsh-nesting birds and Bald Eagles" (ibid). However, localized forest habitat in Maryland, such as mature oak-hickory forests in the Gunpowder Falls River corridor of Baltimore and Carroll Counties, continues to host a diverse avian assemblage of twenty breeding Forest-Interior Dwelling Species[3] (FIDS). This particular habitat is designated as an Important Bird Area (IBA) for neotropical migrants by Birdlife International (Audubon 2012). Species in this area include cerulean warblers, red-headed woodpeckers and scarlet tanagers to name just a few (see Table 2 for a full list). The Prettyboy IBA, as it is known, includes the largest contiguous forest block in Baltimore County and one of three large reservoirs that provide the City of Baltimore with its water supply. This scale of habitat conservation is necessary for the conservation of migratory birds.

Migration

The circumstances and types of migration are variable within this large category of birds. For example, migration distances vary both between species and between individual birds of the same species. Birds that breed in the southern United States and winter in Mexico or the West Indies have the shortest migrations at a few hundred miles. Black-capped vireos, painted buntings and gray catbirds fall into this category. Conversely, birds that inhabit the arctic tundra of northern Canada and winter in Tierra del Fuego, such as the red knot, migrate up to 10,000 miles one-way. Some other birds making the annual long-distance migration to South America include: common nighthawks, red-eyed vireos, purple martins, Swainson's hawks, Connecticut warblers, scarlet tanagers, and bobolinks. These trips can be as long as 13,600 miles round trip (Deinlein 2012).

Migratory birds in the Western Hemisphere travel via four major flyways. Maryland is located within the Atlantic Flyway (Appendix C) and receives both neotropical migrants and migrants from the cold reaches of Canada up through the arctic. Northern species may winter in the mid Atlantic while tropical species come to the area during the summer to breed. Several migrant birds that breed in Maryland, such as the wood thrush and scarlet tanager are long

[3] These are birds defined by Maryland DNR as requiring large, intact patches of forest habitat (Audubon 2012).

distance flyers (see Appendix A). Another, the bobolink, winters in Brazil and northern Argentina and flies distances of 5,000-6,000 miles.

The Atlantic Flyway connects the Northwest Territories of Canada and the Arctic Coast of Alaska to the offshore waters of the Atlantic Coast, via Ohio and West Virginia and the Allegheny Mountains. The Flyway itself is made up of several major routes. The route from the northwest is important to migratory waterfowl and other birds such as flocks of Canvasbacks, Redheads and Lesser Scaups that winter on the waters and marshes south of Delaware Bay. The coastal route of the Atlantic Flyway, which in general follows the shore line, originates in eastern Arctic islands and the coast of Greenland. Over 60 species of neotropical migrants, mostly land birds, use a southern route directly across the Caribbean Sea. They leave Florida en route to Cuba, a distance of 150 miles, with only two possible land masses on which to rest. About half stay the winter in Cuba, while others venture even further to Jamaica, another 90 miles. About a third of the original 60 North American migrants leave the mountains of Jamaica to fly an additional 500 miles of unbroken ocean to the coast of South America (Bird Nature).

Migration allows birds to take advantage of seasonal abundances of food and to avoid food scarcity, as well as avoiding the cold winters of northern regions. Birds travel long distances to assure they will have the food that they need, such as insects, caterpillars, fruits and nectars which helps to assure breeding success. Birds migrate at different times and use different altitudes. Most long-distance migrants travel at night due to the cooler temperatures, calmer air, and fewer predators. These birds, such as songbirds, shorebirds, and waterfowl, travel by flapping there wings, whereas soaring birds such as hawks and vultures take advantage of wind currents present during the day (Nowak 2005, Deinlein 2012). Birds also fly at a variety of altitudes and speeds. Most song birds (nearly three quarters) stick to lower altitudes between 500 and 2,000 feet while some geese and vultures have been observed as high as 37,000 feet. Most birds travel at 15 to 45 miles per hour. They navigate using the stars, the sun, the earth's magnetic field, and even infrasound emitted by mountains and other large topographic features (Nowak 2005).

Discussion of Threats to Migratory Birds

Habitat Loss

Migration, while improving the breeding success of birds, creates the demand that the needs of birds be met during four phases of the year: breeding season, fall migration, wintering, and spring migration; this requires successful management during all four phases (Faaborg et al., 2010). Migratory birds, therefore, are twice impacted by the natural and human hazards that interrupt their migration routes, decrease their habitat, and pollute their environment. Bird mortality is incurred due to collisions with artificial objects such as tall buildings (and other tall structures lit up at night), power lines, and windmills, human-introduced contaminants, and predation from non-native species, such as housecats (USFWS 2010 p.18). Climate change, such as fluctuations in rainfall in tropical wintering areas, is also impacting migratory birds such as the American Redstart (Studds and Marra, 2007, Sillet et. al. 2000)[4]. However, the single largest impact for declining populations of migratory birds is loss or degradation of breeding, stopover, and wintering habitat due to human destruction or disturbance (USFWS 2010 p.12).

Migratory birds have seen declines and changes to breeding and stop-over habitats across North America. Forest and grassland-nesting birds in the U.S. have been most heavily impacted. More than 300 species of birds nest in forests throughout North America. Dozens of unique bird species are also found in grassland habitats such as tallgrass prairies, Polouse prairie in the Pacific Northwest, sagebrush in the Southwest and coastal prairie, in eastern states of Alabama, Florida, and Louisiana, and wetlands throughout the continent (USFWS 1999). Sadly, anthropogenic degradation, such as "suburban sprawl, industrial development and intensification of farming" throughout these habitats has ravaged bird populations, especially in the last 50 years (Audubon 2012- 1)). Ninety-five percent of grasslands have been permanently destroyed or converted to agriculture, resulting in a decrease in abundance of 3 out of 4 grassland species over a 30 year period (up to the year 1999[5]; USFWS 1999). Other grassland habitats have been reduced by more than 90%, for example, native grasslands in San Diego were reduced by 94%

[4] In fact, Studds and Marra (2007) note that the study of migratory birds has been instrumental in revealing the climate change processes: "birds share several life-history traits that have made them instrumental for evaluating the consequences of changing climate: they are widely distributed, highly mobile, their annual cycles hinge on seasonal phenological cues, and they have relatively short generation times. Among the most prominent examples of such research are studies measuring bird responses to rising temperatures along migratory routes or on temperate breeding areas" (p. 115). These studies have revealed changes in bird breeding and migration due to earlier increases in temperature.

[5] These numbers are likely higher in 2012, as habitat destruction and fragmentation continue.

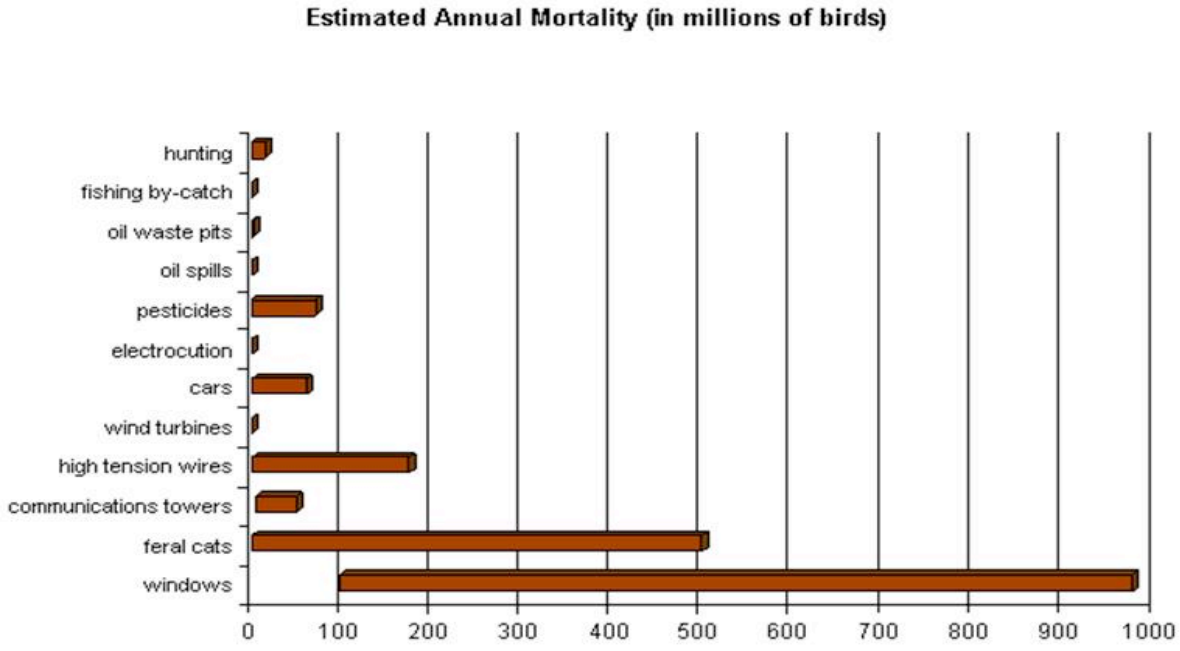
mostly due to development. Remaining grassland habitat exists mostly as fragments, which favor nest-parasitizing bird species like the brown-headed cowbird. Forest habitat has been severely reduced as well, promulgating vast declines in abundance of bird populations. In the central United States "two out of every three woodland species have declined in abundance" (USFWS 1999). Additionally, 99% of the original forests in the eastern US have been cut and replaced (through replanting or regeneration) with lower quality habitat, particularly for neotropical migratory birds (ibid).

Migratory bird stop-over habitat has also suffered severe losses of wetlands and riparian zones. Coastal bird habitat is threatened by sea level rise as a result of global climate change. In Maryland, in particular, 200,000 acres of coastal tidal marsh (a unique intertidal "prairie" habitat) are threatened by rising sea level. Bird species endemic to, or breeding solely in these areas, such as the Salt Marsh Sparrow, the Copper Rail, and the Seaside Sparrow, face an extremely high threat of extinction (Audubon 2012 -1). Over fifty percent of protected habitat for endangered birds is comprised of wetlands. The North American Waterfowl management plan has "protected, restored, or enhanced more than15 million acres of marshes, potholes, and forested wetlands in Canada, the United States, and Mexico between 1986 and 1996" (FWS 1999 p. 2). However, this will be of little use if projections for sea level rise are even minimally met. According to David Curson of Audubon (2012), sea level has increased one foot along the Maryland shore in the past century, and is projected to increase another full meter by the end of the current one. Agencies in Maryland, including the Shorebird Habitat Program are beginning contingency plans to conserve higher elevations of coastal areas with the hope that the marsh, and the birds that inhabit it, will be able to shift their habitat.

Destruction of rainforest in wintering habitat throughout Central and South America is another important factor in the decrease in U.S. nesting species. According to Trulio, "rainforest loss has accelerated in the last three decades" and only 50% of the world's rainforests remain. Changes in land use, including large-scale agriculture, also negatively impact migratory birds. Large monoculture coffee plantations covering thousands of acres devastate bird habitat by removing overstory trees and altering the ecosystem (Trulio 2000). In addition, deforestation in montane regions (such as the Andes) along with the almost complete conversion of campo grasslands, which are prime bird habitat, to wheat fields and other agricultural use has fragmented and greatly reduced suitable habitat throughout South America (Hilty 1994, p. 97).

Migration exposes birds to many natural hazards, but the degree of human-caused mortality from collisions with artificial objects, environmental contamination, and non-native predators, such as house cats, has a devastating cumulative impact on populations of migratory birds (Table 1). Three hundred fifty species of migratory songbirds have been documented to strike communications towers, killing an estimated 4 to 5 million birds annually. It's not understood why birds are attracted to these towers, but it is the focus of concerted research efforts. Additionally, tens of thousands of birds, especially birds of prey, are killed by power lines and related electrical equipment, such as transformers. Inexpensive bird deterrent equipment is available to limit these deaths but is not extensively utilized. Structures and windows that are lit at night attract and kill millions of birds per year, especially songbirds, that tend to migrate at low altitudes at night, and become disoriented by artificial light sources (USFWS 2010 p.18).

Table 1: Causes of Bird Mortality



Estimated numbers of birds killed annually by each of several different causes. Data from various sources. (Sibley Guides 2003)

The copious use of pesticides in the United States creates toxic environments and deleterious effects for many living resources. For birds, in particular, pesticides are responsible for the debilitation and death of at least 65 million individuals a year in the U.S. (according to a conservative estimate in 1992), though the Fish and Wildlife Service suggests that "annual mortality is probably in the hundreds of millions, but deaths are very difficult to document" (USFWS 2010). Other regions where migratory birds live are also impacted. In South America, for example, thousands of Swainson's Hawks are killed each year in Argentina by pesticides targeted to kill grasshoppers. Other birds, such as the Dickcissel in Venezuela[6], are direct targets of biocides (Trulio, 2000). Pesticides, unfortunately, are not the only source of toxic chemicals entering the environments where birds live. Open oil pits, industrial pits, and chemical spills all harbor deadly chemicals that can be fatal to birds. Actual mortality numbers are not available for these sources, but estimates suggest that the overall prevalence of environmental contaminants is such that major cleanup and regulation and enforcement would be needed in order to control the damage to birds.

Predation from birds by house cats and feral cats poses another large threat to birds, especially song birds dwelling in urban and suburban areas. Cats are invasive, non-native predators of birds, causing a shocking estimate of hundreds of millions or wild bird deaths each year (in addition to three times as many small mammals) (USFWS 2010). Researchers found that in Wisconsin alone cats killed an estimated 39 million birds per year (Trulio 2000). Trulio further sites that "Coleman, Temple, and Craven state that worldwide, cats may have been involved in the extinction of more bird species than any other cause, except habitat destruction."[7] Birds are apparently defenseless against cat, which were introduced into the Western Hemisphere from Europe a few hundred years ago. As Trulio puts it, "clawed or declawed, well-fed or hungry, bell or no bell, all cats that spend time outside will hunt and kill birds, as well as other wildlife" (ibid).

The combination of bird mortality and debilitation due to habitat loss and other human-driven threats points to a bleak future for migratory birds. Thankfully, international cooperation through the Migratory Bird Treaty Act, and projects like the Urban Conservation Treaty for

[6] Fortunately several bird conservation organizations, the American Bird Conservancy, The Nature Conservancy, National Fish and Wildlife Foundation and Venezuela Audubon have come together to protect the Dickcissels in Venezuela.

[7] See http://wildlife.wisc.edu/extension/catfly3.htm for article.

Migratory Birds, are working to maintain bird habitat and minimize harm to birds, as well as make cities safer for all birds, migratory and resident (USFWS 2010).

Conservation Goals and Actions

Though the hazards and threats to migratory birds are extreme and numerous, there are many ways that individuals and organizations can become involved. The Urban Conservation Treaty for Migratory Birds provides a useful framework for structuring conservation efforts. The first is to protect and restore bird habitat. In the United States, and especially in urban centers, numerous habitat projects are underway. Many of these can be done by homeowners, such as planting native trees, shrubs, grasses and perennial flowers, and providing shelter for birds. In Maryland, native species, including oak, willow and hawthorn trees, will typically provide a better source of food for birds than non-natives; they host more insects, the food preference of most spring migrants. Dogwoods, native wildflowers and grasses provide fuel for fall seed-eating migrants (Nowak 2005). Park authorities and management authorities can also plant food-source vegetation for birds in transportation corridors and vacant lots and generally revise management plans to incorporate the needs of migratory birds. Enlarging habitat areas in existing parks and creating corridors between parks and other areas should allow bird and other wildlife access to larger areas of habitat (USFWS 2010**)**. Ensuring that these activities are carried out requires public involvement through groups such as Audubon.

In the tropics, planting shade grown coffee helps to restore and maintain habitat. Shade grown coffee plantations support over 90% more species of birds than monoculture sun-grown coffee plantations (Nowak 2005). According to the Smithsonian Migratory Bird Center, “Shade-grown organic coffee plantations stamped with the "Bird Friendly®" seal of approval play a key role in the conservation of our global environment and of migratory birds that find sanctuary in their forest-like environments” (SMBC). Research has shown that maintaining a diverse forest ecosystem in coffee production areas benefits birds in many ways, including providing better sources of food (Johnson 2000), and a greater variety of habitats for resident and migrant birds. Coffee is the world’s most traded commodity, second only to oil. Buying shade grown coffee can make a huge difference.

Schools can participate in any number of habitat projects, such as the National Wildlife Federation Schoolyard Habitat[8] program, which focuses on reconnecting children to the outdoors through the creation of outdoor classrooms. These classrooms help students and teachers attract and support local wildlife. They also provide a place to teach about habitats and ecosystems and the interconnectedness of the natural systems of the planet.

Other ways to conserve and protect migratory birds include: reduce hazards to birds, educate and engage citizens in monitoring, caring about, and advocating for birds and their conservation, foster youth environmental education with a focus on birds, manage invasive species (namely cats) to benefit birds, and increase awareness of the value of migratory birds and their habitats, especially for their intrinsic, ecological and recreational, and economic significance (USFWS 2010, p. 21). Programs such as Lights Out Chicago[9], managed by Chicago Audubon Society encourages building owners to turn off or dim their lights at night, not only reducing collisions, but decreasing energy use that also drives global warming. Finally, American Bird Conservancy's Cats Indoors! Campaign[10] is educating cat owners and decision makers regarding the dramatic toll cat predation is taking on birds, and working to remove free-roaming cats from sensitive wildlife areas, and to persuade cat owners to keep their cats indoors". Bird predation by cats is a huge problem in Maryland's urban areas that might be effectively addressed through a targeted public information campaign.

Cross-Cultural Education Programs

There is a plethora of education programs geared toward bird conservation in general and migratory birds in particular. Cornell Lab of Ornithology[11] hosts a wealth of resources, citizen science projects, and interactive activities regarding bird education. Another program of interest to this project is the Environment for the Americas International Migratory Bird Day[12], which has recently become a year-round celebration of migratory birds and the human cultures who share their world. International Migratory Bird Day, through themes such as "Connecting Cultures", "celebrates and brings attention to one of the most important and spectacular events in

[8] http://www.nwf.org/Get-Outside/Outdoor-Activities/Garden-for-Wildlife/Schoolyard-Habitats.aspx
[9] http://www.lightsout.audubon.org/
[10] http://www.abcbirds.org/abcprograms/policy/cats/index.html
[11] www.birds.**cornell**.edu
[12] www.**birdday**.org

the Americas - bird migration" across North America, Central and South America, and the Caribbean (Environment for the Americas). Similarly, the Smithsonian Migratory Bird Center's Bridging the Americas Program[13] provides opportunities to connect with teachers and students in schools in Central America (Nicaragua, for example) and the Caribbean through bird inspired letters, artwork and projects. The National Park Service's Partners in Flight program also focuses on education programs that transcend national boundaries[14]. These kinds of programs may just be instrumental in engaging the public in conservation efforts.

Conclusion

Migratory birds are amazing animals that inspire our awe and deserve our attention. The enormous loss of birds each year due to human causes is astounding. Hundreds of millions (perhaps billions) of birds are lost annually, but through simple efforts individuals and groups can have an impact on migratory bird conservation. Educating the public regarding migratory bird biology and ecology and creating awareness of the threats to migratory birds will hopefully enhance conservation efforts. Community based and individual actions can impact migratory bird conservation as well. Simply setting a standard (and educating others) of keeping your cat inside, for example, might have a profound impact on protecting birds. The increase in the production of shade grown coffee is another light on the horizon. Buying only Bird Friendly certified coffee will support the maintenance and creation of more coffee plantation ecosystems. Shade grown coffee farms could be a permanent solution in habitat protection, in that they meet the needs of human and animal residents of the rainforest. However, without a concerted effort to minimize habitat loss and fragmentation and the impacts of climate change, bird populations will face insurmountable losses. Large scale efforts to designate and protect critical habitat, such as Birdlife International's Important Bird Areas program is another, are instrumental to migratory bird conservation.

[13] http://nationalzoo.si.edu/scbi/migratorybirds/education/teacher_resources/bridging_the_americas/default.cfm
[14] See Partners in Flight http://www.partnersinflight.org/

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Appendix A

Examples of one-way migration distances

Species	Miles	Breeding Range	Wintering Range
Abbreviations: n=north e=east c=central se=southeast s=south w=west nw=northwest sw=southwest			
Black-capped Vireo	400-1,250	Oklahoma, Texas	w Mexico
Lucy's Warbler	500-1,500	sw U.S.	w Mexico
Painted Bunting	300-3,000	s and se U.S.	Mexico to Panama, West Indies
Northern Parula	300-3,000	se Canada, e U.S.	Florida, West Indies, Mexico to Nicaragua
Wood Thrush	600-3,750	se Canada, e U.S.	Mexico to Panama
Scarlet Tanager	600-4,350	se Canada, e U.S.	nw South America
Cerulean Warbler	2,175-4,500	se Canada, e U.S.	nw South America
Blackpoll Warbler	2,500-5,000	Alaska, Canada, New England	n South America
Purple Martin	600-6,000	s Canada, U.S., Mexico	Brazil, Bolivia to n Argentina
Cliff Swallow	1,250-6,800	Alaska, Canada, U.S., n Mexico	s Brazil, Bolivia to c Argentina
Common Nighthawk	2,500-6,800	most of Canada and U.S.	Colombia to c Argentina
Bobolink	5,000-6,800	s Canada, n U.S.	s Brazil to n Argentina
Swainson's Hawk	3,750-7,500	sw Canada, w U.S.	s Brazil to c Argentina
Lesser Yellowlegs	1,500-9,300	Alaska, n Canada	s U.S., West Indies, South America
Red Knot	1,500-10,000	n Canada	coasts from c U.S. to southern tip of South America

(Smithsonian Migratory Bird Center, 2012) *Highlighting added to denote species that can be found in Maryland.*

Appendix B

List of Species and Data from Prettyboy IBA in Maryland

Species Data and Criteria

Common Name	Date	Seasonal/ Daily	Season	# Observed	Density (#/km2)	Units	Proposed Criteria	Confirmed Criteria
Red-headed Woodpecker	**2007**	D	breeding	1		Individuals		
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz: Frog Hollow Spook Hill - 1 male.						
Hairy Woodpecker	**2007**	D	breeding	5		Individuals		
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.						
	2002	S	breeding			Breeding pairs		
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 6/6 atlas blocks. Forest Interior Dwelling Species.						
Pileated Woodpecker	**2007**	D	breeding	9		Individuals		
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.						
	2002	S	breeding			Breeding pairs		
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 6/6 atlas blocks. Forest Interior Dwelling Species.						
Black-billed Cuckoo	**2007**	D	breeding	1		Individuals		
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz: Hemlock Gorge - 1 male.						
Barred Owl	**2007**	D	breeding	2		Individuals		
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.						
	2002	S	breeding			Breeding pairs		
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 4/6 atlas blocks. Forest Interior Dwelling Species.						
Bald Eagle	**2007**	D	breeding	2		Individuals		
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz: 16 volunteers completing 70km of trail.						
Red-shouldered Hawk	**2007**	D	breeding	6		Individuals		
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.						
	2002	S	breeding			Breeding pairs		
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 5/6 atlas blocks. Forest Interior Dwelling Species.						
Broad-winged Hawk	**2002**	S	breeding			Breeding pairs		
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 2/6 atlas blocks. Forest Interior Dwelling Species.						

Acadian Flycatcher	**2007**	D	breeding	12	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.				
	2007	D	breeding	84	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.				
	2002	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 6/6 atlas blocks. Forest Interior Dwelling Species.				
Yellow-throated Vireo	**2002**	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 5/6 atlas blocks. Forest Interior Dwelling Species.				
Red-eyed Vireo	**2007**	D	breeding	153	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.				
	2002	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 6/6 atlas blocks. Forest Interior Dwelling Species.				
Veery	**2007**	D	breeding	7	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.				
	2002	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 5/6 atlas blocks. Forest Interior Dwelling Species.				
Wood Thrush	**2007**	D	breeding	86	Breeding pairs	
	Source text:	Minimum population estimate based on: Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data 2007 Gunpowder Falls Bird Blitz: Seen on all surveys.				
	2007	D	breeding	43	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz: Seen on all surveys.				
	2002	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 6/6 atlas blocks. Forest Interior Dwelling Species.				
Northern Parula	**2007**	D	breeding	29	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.				
	2002	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 5/6 atlas blocks. Forest Interior Dwelling Species.				
Prairie Warbler	**2007**	D	breeding	22	Breeding pairs	
	Source text:	Minimum population estimate based on: Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data 2007 Gunpowder Falls Bird Blitz: Highest number in one day is 4 seen on CCC Trail, Prettyboy Res.				
	2007	D	breeding	11	Individuals	

		Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz: Highest number in one day is 4 seen on CCC Trail, Prettyboy Res.			
Cerulean Warbler	**2004**	D	breeding	5	Breeding pairs	
		Source text:	Minimum population estimate based on: Terry, Debbie. 2004. Pers. comm. Confirmed nesting along NCRR Trail nr. Blue Mount.			
	2004	D	breeding	1	Individuals	
		Source text:	Terry, Debbie. 2004. Pers. comm. Confirmed nesting along NCRR Trail nr. Blue Mount.			
	2002	S	breeding		Breeding pairs	
		Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 1/6 atlas blocks. Forest Interior Dwelling Species.			
Black-and-white Warbler	**2007**	D	breeding	23	Individuals	
		Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.			
	2002	S	breeding		Breeding pairs	
		Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 5/6 atlas blocks. Forest Interior Dwelling Species.			
American Redstart	**2007**	D	breeding	2	Individuals	
		Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.			
	2002	S	breeding		Breeding pairs	
		Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 2/6 atlas blocks. Forest Interior Dwelling Species.			
Prothonotary Warbler	**2007**	D	breeding	1	Individuals	
		Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz: Gunpowder Loop.			
Worm-eating Warbler	**2007**	D	breeding	102	Breeding pairs	
		Source text:	Minimum population estimate based on: Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data 2007 Gunpowder Falls Bird Blitz: All surveys except Laurel Highlands S.			
	2007	D	breeding	51	Individuals	
		Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz. All surveys except Laurel Highlands S.			
	2002	S	breeding		Breeding pairs	
		Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 6/6 atlas blocks. Forest Interior Dwelling Species.			
Ovenbird	**2007**	D	breeding	132	Individuals	
		Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.			
	2002	S	breeding		Breeding pairs	
		Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 6/6 atlas blocks. Forest Interior Dwelling Species.			
Louisiana Waterthrush	**2007**	D	breeding	58	Breeding pairs	
		Source text:	Minimum population estimate based on: Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data 2007 Gunpowder Falls Bird Blitz.			

	2007	D	breeding	29	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.				
	2002	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 6/6 atlas blocks. Forest Interior Dwelling Species.				
Kentucky Warbler	**2007**	D	breeding	6	Breeding pairs	
	Source text:	Minimum population estimate based on: Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data 2007 Gunpowder Falls Bird Blitz: Frog Hollow/Spook Hill & Gunpowder Loop.				
	2007	D	breeding	3	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz: Frog Hollow/Spook Hill & Gunpowder Loop.				
	2002	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 5/6 atlas blocks. Forest Interior Dwelling Species.				
Hooded Warbler	**2007**	D	breeding	15	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.				
	2002	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 5/6 atlas blocks. Forest Interior Dwelling Species.				
Scarlet Tanager	**2007**	D	breeding	35	Individuals	
	Source text:	Audubon Maryland-DC. 2007. Bird Blitz data forms. unpubl data. 2007 Gunpowder Falls Bird Blitz.				
	2002	S	breeding		Breeding pairs	
	Source text:	Maryland and the District of Columbia Breeding Bird Atlas database 2002-2006. Maryland Ornithological Society. Recorded in 6/6 atlas blocks. Forest Interior Dwelling Species.				

Apendix C
Flyways
http://www.fws.gov/migratorybirds/NewReportsPublications/flyways.html

Atlantic Flyway: from http://www.birdnature.com/atlantic.html