AVIAN MONITORING WITHIN TOURIST AND RESERVE ZONES OF CENTRAL BALKAN NATIONAL PARK, BULGARIA

by

KATHRYN A. SPEAR

(Under the Direction of Sara H. Schweitzer)

ABSTRACT

Human disturbance of ecosystems affects bird communities in many ways, causing avoidance behavior, nest abandonment, increased energy expenditures, decreased fitness, and lowered species richness. Recent changes in Bulgaria have encouraged growth of ecotourism and necessitated development of bio-monitoring programs. My research developed a long-term avian monitoring program to evaluate responses of avian communities to increasing levels of ecotourism for Central Balkan National Park (CBNP), while inspiring collaboration between Bulgaria and the United States. I used variable-radius point counts and distance sampling to survey bird communities in old-growth beech (*Fagus sylvatica*) forests in CBNP on tourist and reserve sites. I used programs DISTANCE to generate density estimates for select species and SPECRICH2 to calculate species richness for tourist and reserve sites. Although more species of conservation significance were found in reserve sites, I detected no difference between estimated species densities or richness in tourist vs. reserve sites.

INDEX WORDS: avian conservation, avian population estimation, beech forest, bio-monitoring, Bulgaria, Central Balkan National Park, DISTANCE, Eastern Europe, ecotourism, human disturbance, variable-radius point count

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DEDICATION

This work is dedicated to my parents, David and Peggy Spear. You have always believed in me and supported me in all of my endeavors. Thank you for the sense of responsibility you have enduringly instilled in me and the opportunities and love you have limitlessly given me.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Human disturbance of ecosystems affects numerous species of wildlife (Goodrich and Berger 1994, Garber and Burger 1995, Kerley et al. 2002, Taylor and Knight 2003). Specifically, bird communities are affected by human disturbance associated with tourism – "the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes" (WTO 2002) – and other recreation activities (Yorio et al. 2001, Sekercioglu 2002, Yasue and Dearden 2006). Human disturbance can reduce bird species richness and abundance (Riffell et al. 1996) and effect avoidance behavior, increasing energy expenditures and decreasing fitness (Frid and Dill 2002). Conversely, some species may be attracted to areas with human disturbance because of urban refuse (Lafferty 2001). Frequently used recreational trails discourage nearby bird nesting (Miller et al. 1998) and feeding (Skagen et al. 1991, Gill et al. 1996). Other types of human disturbance (e.g., camping) also change breeding bird activity budgets by decreasing the time birds spend preening, sleeping, maintaining nests, and feeding themselves and nestlings, possibly decreasing nestling survival and reproductive success (Steidl and Anthony 2000). As the world population grows and tourism levels increase, it will be important to more fully understand the effects of such disturbances and promote biodiversity conservation as much as possible.

Bulgaria was the first European country to develop a National Biological Diversity Conservation Strategy (USAID 2006) and to create a National Ecotourism Strategy and Action Plan (NETSAP; NETSAP 2004). Because Bulgaria joined the European Union in January 2007, westernization and mass tourism are just materializing. The Bulgarian Ministries of Economy, Environment and Water, and Agriculture and Forestry developed NETSAP as an initiative to market sustainable nature conservation programs, local traditions, and cultural sites in the emerging trend of globalization. One of the objectives of the plan is to monitor costs and benefits of ecotourism on the conservation of biodiversity. My research implemented a monitoring system for wild bird populations that Bulgarian biologists can use to monitor the short- and long-term effects of ecotourism initiatives on avian biodiversity.

QUANTIFYING AND CATEGORIZING HUMAN DISTURBANCE

Several methods have been developed to assess and quantify effects of human disturbance on wildlife, including multivariate, experimental, and modeling approaches (Gill et al. 1996, Hill et al. 1997, Gill 2007). Avoidance behavior is a common indicator of intolerance to human disturbance, yet quantifying avoidance behavior alone is not always the most accurate methodology (Gill et al. 2001). Some species of birds might exhibit greater avoidance behavior to human disturbance than others. This differential behavior can be misleading when assessing conservation priorities, because sometimes species that do not flee human disturbance are the most threatened by it; other times, the opposite is true. Therefore, quantifying behavioral responses such as avoidance of human presence may not always be the most accurate assessment of conservation priorities when other factors are not considered and examined simultaneously.

Visitors and park officials report many negative visitor impacts in parks and recreation areas such as trail proliferation, incision, and widening; vegetation and organic litter loss; soil exposure, compaction, and erosion; wildlife disturbance, harassment, and feeding; pollution, littering, and vandalism; and collection of bio-matter (Leung and Marion 2000, Farrell and Marion 2001). These impacts can be assessed using standardized procedures that measure and quantify various trail, vegetation, soil, and tree conditions, such as measuring trail width and incision; estimating tread composition, vegetation cover loss, exposed soil, tree damage, root exposure, and litter; and counting visitor-created trails (Farrell and Marion 2001).

QUANTIFYING AND DECIPHERING IMPACT OF HUMAN DISTURBANCE ON AVIAN COMMUNITY AND POPULATION PARAMETERS

There are many methods available to examine impacts of human disturbance on birds, such as habitat modeling, nest monitoring, and behavioral observations (Yasue and Dearden 2006). Studies of time allotments of bird activity budgets have been used to quantify effects of human disturbance on breeding birds and have found that such disturbances affect nestling survival and reproductive success (Safina and Burger 1983, Steidl and Anthony 2000, Mullner et al. 2004, Sabine et al. 2008). Assessments of avian richness and abundance in relation to hiker presence have been used to evaluate effects of human disturbance on birds because such disturbances cause birds to move to and from sites (Riffell et al. 1996). This movement behavior can be detrimental to birds because it expends unnecessary time and energy, leaves nests and eggs/hatchlings unattended, increases visibility to predators, and can eventually cause nest abandonment. The distance at which birds exhibit alert behavior relative to human activity is a good indication of disturbance tolerance and can assist successful park design and management plans (Fernandez-Juricic et al. 2001). Ideally, wildlife should be disturbed as little as possible. However, any human presence will cause some disturbance. Well-designed, statistically robust monitoring programs (Daw et al. 2004) must be used to assess the extent of disturbance and ensure it does not pose too great a threat to bird populations. Depending on the specific goals and concerns of different locations, population parameters should not increase greatly (as with "nuisance" species, for example) or decrease significantly (as with species of conservation significance) in response to human activities. Disturbance should be allowed only at levels where these scenarios cannot yet occur. Avian point counts (Ralph et al. 1995) are the foundation of many avian monitoring programs and offer a method of abundance and density estimation, especially in rugged terrain. Hence, many methods of analyzing point count data that account for detection rates and various survey designs have been developed and are readily available (Fancy 1997, Royle and Nichols 2003, Royle 2004, Kery et al. 2005, Buckland 2006).

DEVELOPMENT OF ECOTOURISM IN BULGARIA

Because Bulgaria is in transition and people want to increase their economic well-being as Western Europe and the United States have done, it is likely that economic growth in the tourism industry may be modeled after other mass tourism operations, many of which are unsustainable. However, the desire in Bulgaria to maintain its cultural identity and natural resources culminated into the NETSAP that provides guidelines for ecotourism growth. Sustainable tourism and ecotourism are rising in popularity among travelers and can be economically beneficial while also assisting in resource conservation (Eubanks et al. 1993, Sekercioglu 2002, Scott and Thigpen 2003, Entrepreneur 2005, Tsui 2006). Yet the negative effects of human activities on natural resources, specifically, should be considered in tourism development and implementation. With planning and information on how much disturbance ecosystems can withstand without degradation of their functions, ecotourism in Bulgaria can sustainably support the nation's economy and provide lasting jobs for people in small, rural communities (NETSAP 2004). A stable, rural economy, partially based on responsible use of natural resources, will encourage people to stay in rural communities rather than migrate to cities. Talented younger people are more likely to stay in rural communities if fulfilling small-business opportunities exist, such as those working with nature and ensuring its use is sustainable. If the economy declines, more people will emigrate – Bulgaria has already experienced this "brain drain" to an extent (Chompalov 2000). Thus, a secure economy is supported by a stable ecology, especially in rural areas.

Bulgaria has been a stable country in the Balkans throughout its transition from a communist government to a parliamentary democracy (1989-present); however, several adjoining Balkan countries have not been stable (Albania, Croatia, Macedonia, Montenegro) and others are still not (Bosnia and Herzegovina, Kosovo, Serbia). South of Bulgaria, Turkey is not absolutely stable; neither are Iran and Iraq. Bulgaria is strategically located and has been used as a stopover site for U.S. troops and airplanes en route to the Middle East; hence, it is an important partner for the U.S. government. It is important for U.S. foreign policy to maintain its partnership with Bulgaria and for Bulgaria to remain politically secure and have a growing but sustainable economy. To foster stability and economic growth, the U.S. Agency for International Development (USAID) funded planning and pilot work for development of ecotourism, as well as small, sustainable business initiatives (Global Environment Facility [GEF] grants) from 1995-2004.

Bulgaria entered the EU under rigid stipulations and must fulfill several EU initiatives and treaties (including Natura 2000 requirements [CEC 2002] and Europe's Protected Area Network [PAN] Park initiative [PAN Parks 2006]). Information on Bulgaria's current ecological conditions (baseline data) must be obtained so that alterations to them, relative to uses of natural resources for tourism or other activities, can be detected. These data must be obtained using statistically solid, robust ecological monitoring programs so they can be examined over years and among locations, with confidence in the results. Relatively little biodiversity monitoring research has been implemented in this region. My research provides the groundwork for creating an avian monitoring program, incorporating international collaboration, while simultaneously providing a means of preserving biodiversity and local culture in a forthcoming ecotourism environment.

STUDY OVERVIEW

The objectives of my project were to create an avian monitoring protocol for Central Balkan National Park (CBNP) that park officials could continue to implement for several years. Part of this goal included obtaining initial estimates of species densities for future years' comparison. We sampled bird populations on tourist and reserve sites and estimated species richness for both types of sites. Because previous studies detected effects on avian species by human disturbance, we hypothesized that birds would be affected by tourist disturbance in our study sites. We expected to see a different suite of species in reserve sites because of the lack of human activities, as well as paths and openings, in the forest. We expected also to find greater species richness in reserve sites, plus more species of conservation significance. This introduction provides background information on human disturbance in natural areas, particularly on avian populations, as well as current issues in Bulgaria pertinent to this project. The following chapter discusses the study area, project design, field methods, data analysis, results, and discussion in a manuscript format. The third and final chapter discusses management suggestions, future research needs and other research conclusions.

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CHAPTER 2

AVIAN MONITORING WITHIN TOURIST AND RESERVE ZONES OF CENTRAL BALKAN NATIONAL PARK, BULGARIA[1]

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INTRODUCTION

Human disturbance of ecosystems affects numerous species of wildlife (Goodrich and Berger 1994, Garber and Burger 1995, Kerley et al. 2002, Taylor and Knight 2003). Specifically, bird communities are affected by human disturbance, including tourism and other recreation activities (Yorio et al. 2001, Sekercioglu 2002, Yasue and Dearden 2006). Human disturbance can reduce bird species richness and abundance (Riffell et al. 1996) and effect avoidance behavior, increasing energy expenditures and decreasing fitness (Frid and Dill 2002). Frequently used recreational trails discourage nearby bird nesting (Miller et al. 1998) and feeding (Skagen et al. 1991, Gill et al. 1996). Other types of human disturbance (e.g., camping) also change breeding bird activity budgets by decreasing the time birds spend preening, sleeping, maintaining nests, and feeding themselves and nestlings, possibly decreasing nestling survival and reproductive success (Steidl and Anthony 2000). As the world's human population grows and tourism levels increase, it will be important to alleviate such disturbances and promote conservation of biodiversity as much as possible.

There are many methods to examine impacts of human disturbance on birds, such as habitat modeling, nest monitoring, and behavioral observations (Yasue and Dearden 2006). Studies of time allotments of bird activity budgets have been used to quantify effects of human disturbance on breeding birds and have found that such disturbances can affect nestling survival and reproductive success (Safina and Burger 1983, Steidl and Anthony 2000, Mullner et al. 2004, Sabine et al. 2008). Assessing avian richness and abundance in relation to hiker presence has been used to evaluate effects of human disturbance on birds because such disturbances cause birds to move to and from sites (Riffell et al. 1996). This behavior can be detrimental to birds because it expends unnecessary time and energy, leaves nests and eggs/hatchlings unattended, increases their visibility to predators, and can eventually cause nest abandonment. The distance to human activity at which birds exhibit alert behavior is a good indication of disturbance tolerance and can assist with designing successful park management plans (Fernandez-Juricic et al. 2001). Ideally, wildlife should be disturbed as little as possible. However, any human presence will cause some disturbance. Monitoring programs (Daw et al. 2004) are essential for assessing the extent of this disturbance to ensure it does not pose too great a threat to bird populations. Depending on the specific goals and concerns of different locations, population parameters should not increase greatly (as with "nuisance" species, for example) or decrease significantly (as with species of conservation significance) in response to human activities. Disturbance should be allowed only at levels where these scenarios cannot yet occur. Avian point counts (Ralph et al. 1995) are the foundation of many avian monitoring programs and offer a method of abundance and density estimation, especially in rugged terrain. Hence, many methods of analyzing point count data that account for detection rates and various survey designs have been developed and are readily available (Fancy 1997, Royle and Nichols 2003, Royle 2004, Kery et al. 2005, Buckland 2006).

Bulgaria entered the European Union under rigid stipulations in January 2007 and must fulfill several EU initiatives and treaties (including Natura 2000 requirements [CEC 2002] and Europe's Protected Area Network [PAN] Park initiative [PAN Parks 2006]). However, westernization and mass tourism in Bulgaria are increasing rapidly. To buffer the desire for rapid development and the need to meet EU initiatives and treaties that protect biodiversity, Bulgaria developed a National Biological Diversity Conservation Strategy (USAID 2006) and created a National Ecotourism Strategy and Action Plan (NETSAP; NETSAP 2004). The Bulgarian Ministries of Economy, Environment and Water, and Agriculture and Forestry developed

NETSAP as an initiative to market sustainable nature conservation programs, local traditions, and cultural sites in the emerging trend of globalization. One of the objectives of NETSAP is to monitor costs and benefits of ecotourism on biodiversity conservation. Our research developed and tested a monitoring system for wild bird populations that Bulgarian biologists can use to monitor the short- and long-term effects of ecotourism initiatives on wildlife biodiversity.

STUDY AREA

Of the 760 bird species recorded in Europe, Bulgaria is home to 405 (Aladzhem 2000). Bulgaria is unique because it contains both an extraordinary diversity of wildlife and is not yet inundated with Western development and tourism that threaten and prevent the preservation of natural ecosystems. Central Balkan National Park (CBNP; Figure 1), established in 1991 and a Protected Area Network (PAN) park of Europe (PAN Parks 2006), comprises just 0.6% (716 sq km) of the total land area of Bulgaria; however, 45% of the country's nesting bird species are found within its territory (CBNP date unknown). It is a site of global importance for 224 species of birds, and during the nesting season, 123 species of birds reside in the park. The CBNP is of national conservation significance for many species of birds, including the golden eagle *(Aquila chrysaetos*), kestrel (*Falco tinnunculus*), rock partridge (*Alectoris graeca*), eagle owl (*Bubo bubo*), Ural owl (*Strix uralensis*), pygmy owl (*Glaucidium passerinum*), red-breasted flycatcher (*Ficedula parva*), and black woodpecker (*Dryocopus martius*). It is also home to globally endangered species, such as the imperial eagle (*Aquila heliaca*), corncrake (*Crex crex*), and ring ouzel (*Turdus torquatus*). Additionally, threatened species, such as the semi-collared flycatcher (*Ficedula semitorquata*) and southern white-backed woodpecker (*Dendrocopos leucotos*), are present. Several threats to avian populations exist within the park, such as the potential reduction of the park's total area; poaching; lack of a pre-park zone, or protective buffer, around the park boundary; old forest logging; and souslik (*Spermophilus citellus*) colony extinctions (Sakalian 2000). The souslik is a small mammal and main food item for many birds of prey. Its population decline has precipitated the decline of several species of birds of prey.

The CBNP is approximately 85 km long (CBNPMP 2001). Fifty-six percent of the park is forested, and 44% of the entire park area is comprised of beech forests (Figure 2). Forty-four percent of the park consists of high-altitude pastures and meadows. The terrain is rugged, and the highest peak reaches 2,376 m a.s.l. There are nine nature reserves in the park with a total area of approximately 20,000 ha, or 28% of the park's total area (Figure 3). Forty percent of the park's forest area is designated as reserve zones; 21% as water protection zones; 10% for anti-erosion; 3% for buffer zones; and 26% for other purposes. Limited livestock grazing and collection of medicinal plants are allowed in the park. May and June are the months of most avian breeding activity. The climate during these months is sunny and dry, with average temperatures ranging from 15-25 degrees Celsius. Our study sites, at an approximate average elevation of 1,000 m a.s.l., were located in the southeastern region of the park near the town of Kalofer.

METHODS

We performed variable-radius point counts (MELP 1999, Fancy and Sauer 2000, Rosenstock et al. 2002, Daw et al. 2004) within three study sites in CBNP. Each site had two sub-sites that represented areas with different levels of human disturbance. All sites were within the beech (*Fagus sylvatica*) forest belt (CBNPMP 2001:24-25). Disturbance levels were classified into present (tourist zones) and absent (reserve zones), according to existing park data (CBNPMP 2001:120-123; 125-131). In tourist zones, hikers were allowed on designated trails, while in reserve zones, no uses were allowed.

We placed 3-5 count stations on each sub-site for a total of 28 count stations. The number of count stations varied among sub-sites because of differing accessibility. Count stations in tourist zones were along trails; count stations in reserve zones were through the forest as there were no trails other than game trails. Each count station had a proposed initial radius of 50 m; total distance between count station centers was 200 m. We counted at each point 3-4 times during June 2007 and May 2008. During each count, we recorded each bird species detected visually and/or aurally, time detected, and estimated distance from center point. We counted for 10 min in 2007 and 7 min in 2008. The count time was reduced in 2008 to avoid double-counting; we observed few new birds during the last 3 min of the counts in 2007 (Appendix A).

Data from all counts were pooled into one tourist data set and one reserve data set for analysis. We used program DISTANCE (Buckland et al. 2001, Thomas et al. 2006) to analyze count data, develop detection rates, and obtain density estimates for five species with sufficient sample sizes (blackbird, *Turdus merula*; chaffinch, *Fringilla coelebs*; great tit, *Parus major*; robin, *Erithacus rubecula*; and wood warbler, *Phylloscopus sibilatrix*). Models were created with variations of uniform, half-normal, and hazard-rate detection functions, and cosine and simple polynomial adjustment terms. We created variations of global models, and models stratified between tourist and reserve sites. The models were ranked by AIC_c weight and the best model was selected to obtain density estimates based on lowest AIC_c value. We calculated species richness for tourist and reserve sites using program SPECRICH2 (White et al. 1978, Rexstad and Burnham 1991). We performed a t-test to detect differences between species richness within tourist and reserve sites. Our a priori level of significance was set at $P \leq 0.05$.

RESULTS

We observed 58 species of birds in our study sites, including 12 species of conservation significance (Tables 1 and 2). We observed 42 species in tourist areas and 46 species in reserve areas. Twenty-eight of the total 58 species observed were not found in both types of sites. We detected 16 unique species in reserve sites, and 12 in tourist sites.

Models from neither tourist nor reserve sites produced consistently higher density estimates (Table 3). There was no difference between top global and stratified models. We defined our top models by their respective detection function and, if applicable, adjustment term (Table 4). We chose to report density estimates from stratified models, as our goal was to obtain estimates for both tourist and reserve sites. The species richness estimate within tourist sites was 67 species (SE = 10.4), while that within reserve sites was 71 species (SE = 11.1). We detected no difference between these richness estimates ($t = 0.26$, df = 11).

DISCUSSION

Although we expected reserve sites to provide prime habitat for many species because they received no disturbance from human activities, we did not detect a difference between densities of birds in tourist and reserve sites. We estimated densities of only five species of the 58 species detected because these five were observed a sufficient number of times (≥ 40-50 detections) for analysis in program DISTANCE. Consequently, these species were all common species that display tolerance of human disturbance. They are found across Europe, including in urban green areas (Mullarney et al. 1999).

Although we expected reserve sites to have a greater level of species richness because they might offer more available niches in undisturbed habitat, we did not detect a difference between species richness in tourist and reserve sites. However, the suite of birds found in reserve sites included 16 species not detected in tourist sites; further research is needed to determine if these species are easily disturbed by human activities in the park and therefore seek undisturbed areas. Conversely, in tourist sites, abundant, human-tolerant birds may exclude shy, human-intolerant species, thus decreasing species richness. Most species of concern that we observed were in reserve sites, suggesting these species are intolerant of human activities and need reserve sites for life requisites. Hence, reserve zones are critical for continued existence of these species of concern and should be maintained as undisturbed habitat by the CBNP. If tourist activities increase in abundance and frequency in CBNP, bird species richness in tourist sites may decline significantly, thereby further increasing the importance of reserve zones for species of concern and overall avian species richness.

We assumed that any differences between sites would be associated with human disturbance activities. However, for future monitoring, other factors that could cause differences should be taken into account, such as amount of ground cover, tree density, and other quantifiable habitat characteristics, as well as any historical differences between sites that may have led to the designation of the reserve sites as protected areas.

The population estimation methodology we used, variable-radius point counts, is appropriate for rugged terrain and birds that can be detected aurally and/or visually. However, assumptions of models (e.g., DISTANCE) used to estimate population attributes from distance-sampling data are difficult to meet (Alldredge et al. 2007, Alldredge et al. 2008). In our study, birds consistently moved away from the center point during counts, creating a donut effect (low frequency of detections around the center point and numerous detections around approximately 20 m, with fewer detections 25-30$^+$ m from center), violating the assumption that animals would not move in response to the observer and affect correct detection of animals relative to the count station center.

Additionally, some density estimates, for the chaffinch especially, seem unrealistically high, suggesting double counting might have occurred. We offer suggestions for addressing these issues in the sampling protocol in the next section. It is possible, however, that alterations will need to be made in the method of data analysis as well. There is some evidence of problems associated with distance sampling, such as difficulty in recording accurate distances (Alldredge et al. 2007) or the tendency to “heap” distances (i.e., to round distances to numbers such as 20 instead of 19 or 21, for example; Alldredge et al. 2008). The extensive level of resources (financial and time spent training and in the field) can be a burden. A data analysis method such as occupancy analysis (Royle and Nichols 2003, MacKenzie et al. 2006) could alleviate some of the complications associated with distance analysis while simultaneously enabling CBNP officials to sample over the entire park with the resources available to them. We suggest that some of the alternatives mentioned in the next section be considered to address the problems we encountered.

We successfully reached our goal of creating an avian monitoring program for CBNP that park officials will continue to implement in the future. We provided a limited, initial avian biodiversity assessment for areas in Central Balkan National Park that can be used for comparison in future ecotourism/biodiversity monitoring studies. This monitoring program will serve as a template and framework for researchers and park officials to continue the program, not only on these study sites, but also in an expanded network of study sites across the entire park. Ultimately, estimating the level of disturbance that results in negative bird community responses will be detected; thus, park officials will be able to restrict disturbance to an acceptable level based on scientifically collected data.

MANAGEMENT IMPLICATIONS

The overall goal of this project was to create an avian monitoring program that CBNP officials can continue to implement so that avian biodiversity may be monitored as time passes and development and tourism pressure likely increase. We highly recommend CBNP continue monitoring avian populations, especially considering the country's rapidly changing political and socioeconomic conditions. Additionally, it is essential that data pertaining to the number of visitors using the tourist sites be collected throughout the year. Knowing the intensity of tourist use and how it varies at different sites and during different times of the year--and during different stages of birds' life cycles, such as the breeding season--is a necessary component of gauging human impact through the monitoring program. Monitoring is an essential component of adaptive resource management (Lancia et al. 1996, Lyons et al. 2008). Management practices must be evaluated through monitoring; otherwise, we have no indication if they are worthwhile expenditures of time and money, or if they are having detrimental effects. Similarly, research programs must continually be updated and improved upon as they "learn" from dynamic monitoring data. As the park develops specific questions and goals pertaining to avian populations and tourist disturbance in the park, adaptive resource management could be an optimal tool for addressing these questions and making sound management decisions. Monitoring programs will be a key component in this process.

Strict field protocol must be observed while conducting point counts to alleviate any unnecessary movement of birds away from the center point. Once fully trained, only one observer should be present to reduce the amount of noise potentially scaring away the birds (unless employing a double observer approach). The observer should wait quietly for approximately five minutes once arriving at the point before beginning the count so that any birds initially startled away by the observer's arrival will have returned. Any behaviors that might potentially alter normal bird presence and activity, such as talking, smoking, or cell phone use, should be strictly prohibited. Adhering to these practices will provide more reliable data.

Other alternatives include using a different data analysis approach. Occupancy analysis produces abundance estimates from presence-absence data. It is a potential alternative that avoids some of the problems encountered in DISTANCE and does not require as much time and effort as distance methods (Royle and Nichols 2003). This alternative might be ideal for CBNP or any project where resources are limited, and the simpler protocol would allow a greater opportunity for spatial replication of counts and for the possibility of trained, volunteer birders conducting counts. The data collection procedures need not change if CBNP officials wish to explore occupancy analysis (although recording distance estimates can be eliminated, but distance analysis will no longer be an option). We recommend investigating occupancy analysis in program MARK (White and Burnham 1999) and exploring emerging literature for implementation guidelines (Royle and Nichols 2003, MacKenzie et al. 2006).

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IARO fellowship was provided by the United States Department of State through the Title VIII Program and the IREX Scholar Support Fund. None of these organizations are responsible for the views expressed herein. G. T. Green, C. T. Moore, and K. Pacifici provided extensive assistance in the preparation, analysis, and support of this research. J. P. Carroll, M. J. Conroy, and B. J. Mattsson provided beneficial advice. J. Iole and M. L. McElroy provided field assistance, and J.P. Bond assisted with graphic design and photography.

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Table 1. Bird species detected during point counts in tourist sites within the beech forest (*Fagus sylvatica*) of Central Balkan National Park, Bulgaria, June 2007 and May 2008. An asterisk (*) indicates species of conservation significance (CBNPMP 2001).

Common Name	Scientific Name
*Black Woodpecker	*Dryocopus martius*
Blackbird	*Turdus merula*
Blue Tit	*Parus caeruleus*
Buzzard	*Buteo buteo*
Chaffinch	*Fringilla coelebs*
Chiffchaff	*Phylloscopus collybita*
Coal Tit	*Parus ater*
Cuckoo	*Cuculus canorus*
Dipper	*Cinclus cinclus*
Garden Warbler	*Sylvia borin*
Goldfinch	*Carduelis carduelis*
Goshawk	*Accipiter gentilis*
Great Spotted Woodpecker	*Dendrocopos major*
Great Tit	*Parus major*
Greenfinch	*Carduelis chloris*
Grey Wagtail	*Motacilla cinerea*
Hoopoe	*Upupa epops*
Jay	*Garrulus glandarius*
*Kestrel	*Falco tinnunculus*
Lesser Whitethroat	*Sylvia curruca*
Magpie	*Pica pica*
Middle Spotted Woodpecker	*Dendrocopos medius*
Mistle Thrush	*Turdus viscivorus*
Nutcracker	*Nucifraga caryocatactes*
Nuthatch	*Sitta europaea*
Raven	*Corvus corax*
Red-breasted Flycatcher	*Ficedula parva*
Robin	*Erithacus rubecula*
*Skylark	*Alauda arvensis*
Sombre Tit	*Parus lugubris*
Song Thrush	*Turdus philomelos*
*Spotted Flycatcher	*Muscicapa striata*
Starling	*Sturnus vulgaris*
Swift	*Apus apus*
Three-toed Woodpecker	*Picoides tridactylus*
Treecreeper	*Certhia familiaris*
White Wagtail	*Motacilla alba*
Wood Warbler	*Phylloscopus sibilatrix*

Table 1, cont. Bird species detected during point counts in tourist sites within the beech forest (*Fagus sylvatica*) of Central Balkan National Park, Bulgaria, June 2007 and May 2008. An asterisk (*) indicates species of conservation significance (CBNPMP 2001).

*Woodlark	*Lullula arborea*
Woodpigeon	*Columba palumbus*
Wren	*Troglodytes troglodytes*
Yellow Wagtail	*Motacilla flava*

Table 2. Bird species detected during point counts in reserve sites within the beech forest (*Fagus sylvatica*) of Central Balkan National Park, Bulgaria, June 2007 and May 2008. An asterisk (*) indicates species of conservation significance (CBNPMP 2001).

Common Name	Scientific Name
*Black Woodpecker	*Dryocopus martius*
Blackbird	*Turdus merula*
Blue Tit	*Parus caeruleus*
Buzzard	*Buteo buteo*
Chaffinch	*Fringilla coelebs*
Coal Tit	*Parus ater*
Corn Bunting	*Miliaria calandra*
Cuckoo	*Cuculus canorus*
Dipper	*Cinclus cinclus*
Dunnock	*Prunella modularis*
*Golden Eagle	*Aquila chrysaetos*
Golden Oriole	*Oriolus oriolus*
Goldfinch	*Carduelis carduelis*
Great Spotted Woodpecker	*Dendrocopos major*
Great Tit	*Parus major*
*Green Woodpecker	*Picus viridis*
Greenfinch	*Carduelis chloris*
Grey Partridge	*Perdix perdix*
Grey Wagtail	*Motacilla cinerea*
Hobby	*Falco subbuteo*
Jay	*Garrulus glandarius*
*Kestrel	*Falco tinnunculus*
Lesser Spotted Woodpecker	*Dendrocopos minor*
Linnet	*Carduelis cannabina*
Long-tailed Tit	*Aegithalos caudatus*
Magpie	*Pica pica*
Middle Spotted Woodpecker	*Dendrocopos medius*
Nuthatch	*Sitta europaea*
Raven	*Corvus corax*
*Red-backed Shrike	*Lanius collurio*
Red-breasted Flycatcher	*Ficedula parva*
*Redstart	*Phoenicurus phoenicurus*
Robin	*Erithacus rubecula*
*Rock Bunting	*Emberiza cia*
Song Thrush	*Turdus philomelos*
*Spotted Flycatcher	*Muscicapa striata*
Starling	*Sturnus vulgaris*
Treecreeper	*Certhia familiaris*

Table 2, cont. Bird species detected during point counts in reserve sites within the beech forest (*Fagus sylvatica*) of Central Balkan National Park, Bulgaria, June 2007 and May 2008. An asterisk (*) indicates species of conservation significance (CBNPMP 2001).

White Wagtail	*Motacilla alba*
*White-backed Woodpecker	*Dendrocopos leucotos*
Wood Warbler	*Phylloscopus sibilatrix*
*Woodlark	*Lullula arborea*
Woodpigeon	*Columba palumbus*
Wren	*Troglodytes troglodytes*
*Wryneck	*Jynx torquilla*
Yellowhammer	*Emberiza citrinella*

Table 3. Density estimates generated from program DISTANCE for five species detected during point counts within the beech forest (*Fagus sylvatica*) of Central Balkan National Park, Bulgaria, June 2007 and May 2008. Estimate equals individuals per 50-m-radius point count circular plot.

Species	Tourist Estimate	95% Confidence Intervals		Reserve Estimate	95% Confidence Intervals	
2007						
Blackbird	1.7	0.8	3.6	0.7	0.3	1.6
Chaffinch	25.3	10.6	60.7	27.6	11.5	66.5
Great Tit	11.9	9.3	15.1	13.4	9.5	18.9
Robin	5.3	2.8	9.9	6.1	2.5	14.9
Wood Warbler	6.8	4.0	11.3	4.3	2.2	8.4
2008						
Blackbird	2.3	1.1	4.6	2.1	1.1	4.1
Chaffinch	17.1	10.1	29.1	17.9	11.1	28.7
Great Tit	5.6	3.3	9.5	4.9	2.6	9.5
Robin	8.4	5.8	12.1	8.5	5.1	14.2
Wood Warbler	7.5	5.0	11.2	7.7	5.1	11.5

Table 4. Model selection from program DISTANCE for five species detected during point counts within the beech forest (*Fagus sylvatica*) of Central Balkan National Park, Bulgaria, June 2007 and May 2008. The top three models for each species for each year are shown.

Species	Model	AIC	AIC_c	Δ AIC
2007				
Blackbird	Uniform	168.26	168.26	0.00
	Hazard-rate	176.37	177.17	8.11
	Half-normal	177.09	177.34	8.83
Chaffinch	Uniform & Half-normal Simple polynomial	1628.92	1629.17	0.00
	Hazard-rate	1633.16	1633.21	4.24
	Uniform Cosine	1639.51	1639.67	10.59
Great Tit	Hazard-rate	676.32	676.44	0.00
	Uniform Simple polynomial	679.38	679.42	3.06
	Half-normal Simple polynomial	680.43	680.55	4.10
Robin	Uniform Cosine	158.59	158.78	0.00
	Hazard-rate	159.45	160.02	0.86
	Half-normal	159.49	159.67	0.90
Wood Warbler	Hazard-rate	364.35	364.58	0.00
	Uniform Simple polynomial	368.78	369.01	4.43
	Half-normal Simple polynomial	369.71	369.93	5.35
2008				
Blackbird	Uniform	299.41	299.41	0.00
	Half-normal	301.41	301.51	2.00
	Hazard-rate	303.41	303.71	4.00
Chaffinch	Uniform Simple polynomial	1279.15	1279.28	0.00
	Hazard-rate	1282.13	1282.20	2.99
	Uniform Cosine	1282.60	1282.67	3.45
Great Tit	Uniform Cosine	410.11	410.19	0.00
	Half-normal	410.63	410.70	0.52
	Uniform Simple polynomial	410.88	410.95	0.76
Robin	Uniform Cosine	433.47	433.54	0.00
	Hazard-rate	433.72	433.93	0.25
	Uniform Simple polynomial	434.16	434.37	0.69
Wood Warbler	Uniform Simple polynomial	689.57	689.61	0.00
	Hazard-rate	689.60	689.73	0.03
	Half-normal	689.70	689.74	0.13

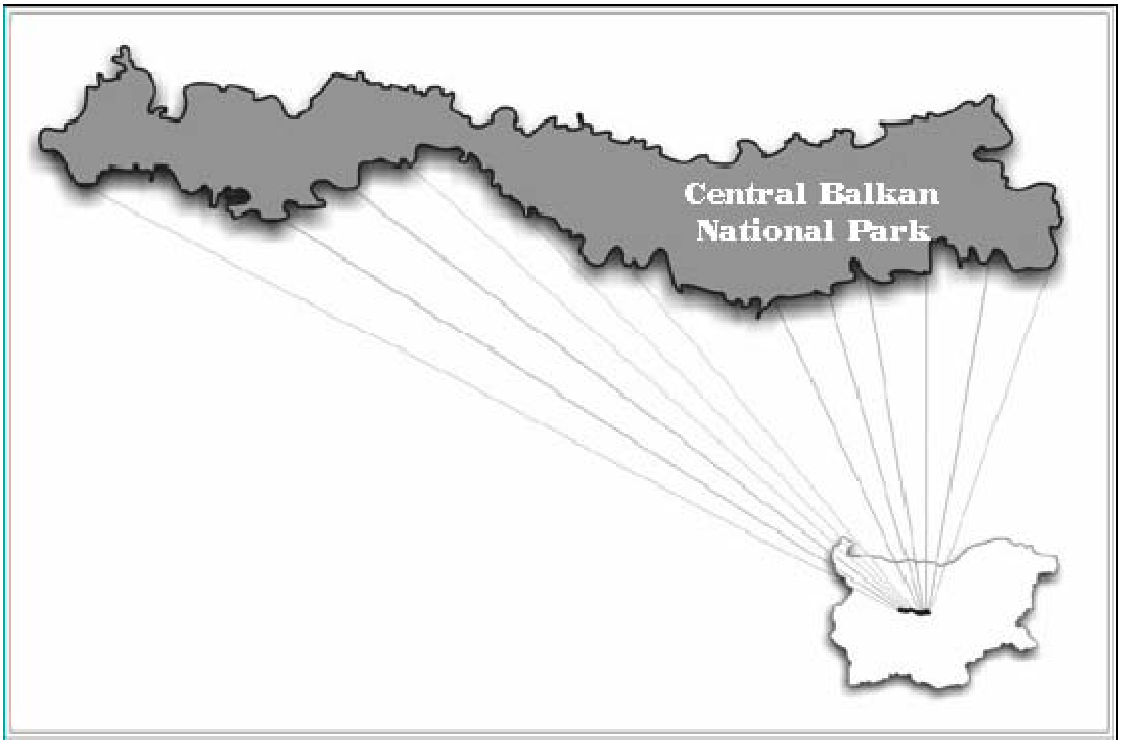
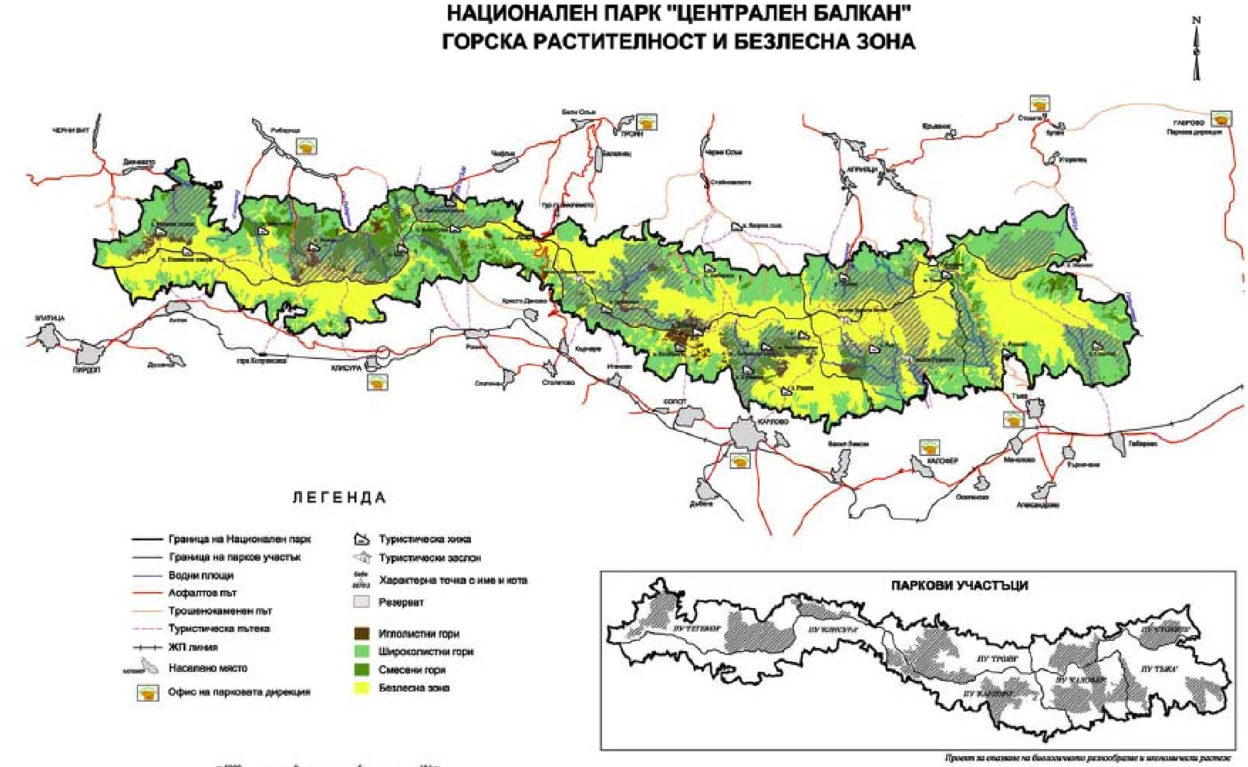


Figure 1. Central Balkan National Park, Bulgaria (CBNPMP 2001).



LEGEND TRANSLATION (corresponding order)

National Park Boundary	Tourist Chalet
Park Section Boundary	Tourist Shelter
Water Area	Peaks with Elevation and Name
Asphalt Road	Reserve
Macadam Road	
Tourist Trail	Coniferous Forest
Railway Lines	Deciduous Forest
Urban Area	Mixed Forest
National Park Directorate Office	Treeless Zone

Figure 2. Central Balkan National Park Forest Vegetation and the Treeless Zone (CBNPMP 2001).

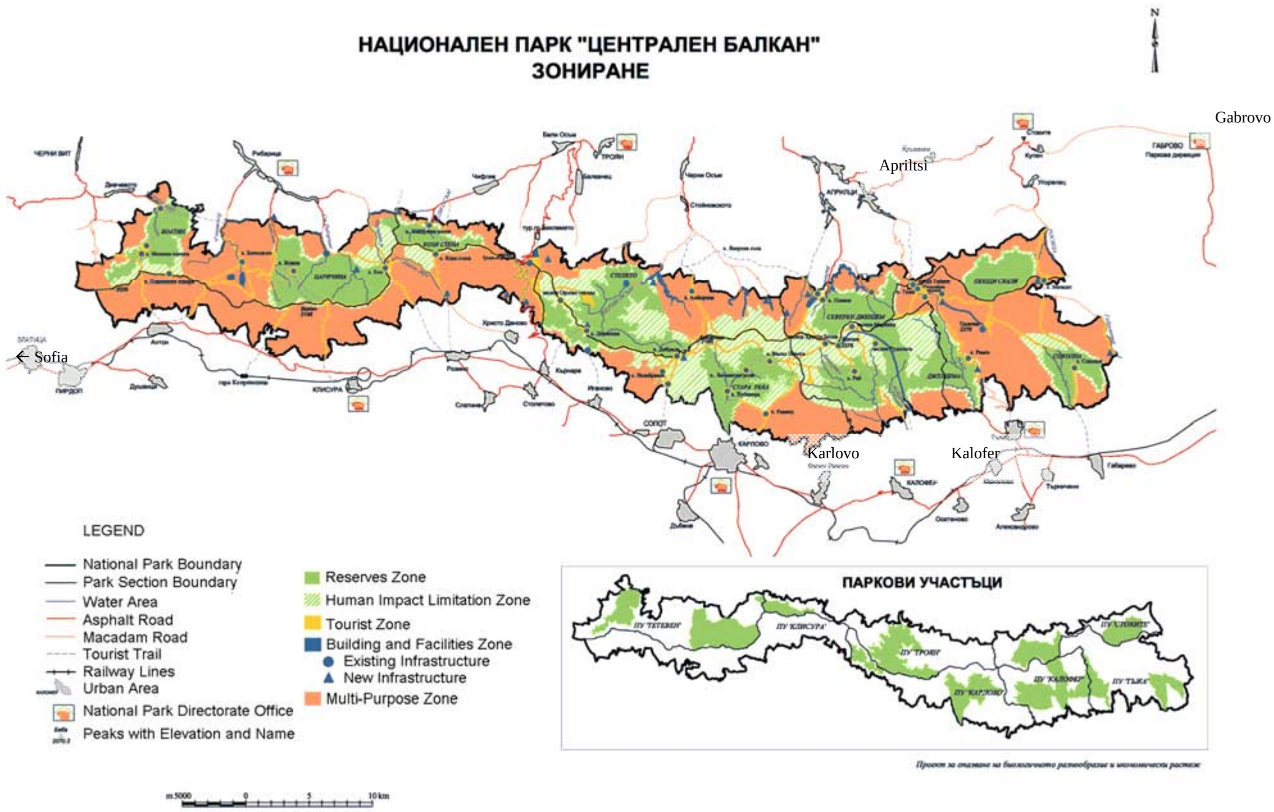


Figure 3. Central Balkan National Park Zoning Map (CBNPMP 2001).

CHAPTER 3

CONCLUSION

The overall goal of this project was to create an avian monitoring program that CBNP officials can continue to implement so that avian biodiversity may be monitored as time passes and development and tourism pressure likely increase. I highly recommend CBNP continue monitoring avian populations, especially considering the country's rapidly changing political and socioeconomic conditions. Additionally, it is essential that data pertaining to the number of visitors using the tourist sites be collected throughout the year. Knowing the intensity of tourist use and how it varies at different sites and during different times of the year--and during different stages of birds' life cycles, such as the breeding season--is a necessary component of gauging human impact through the monitoring program. Monitoring is an essential component of adaptive resource management (Lancia et al. 1996, Lyons et al. 2008). Management practices must be evaluated through monitoring; otherwise, we have no indication if they are worthwhile expenditures of time and money, or if they are having detrimental effects. Similarly, research programs must continually be updated and improved upon as they "learn" from dynamic monitoring data. As the park develops specific questions and goals pertaining to avian populations and tourist disturbance in the park, adaptive resource management could be an optimal tool for addressing these questions and making sound management decisions. Monitoring programs will be a key component in this process.

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Other alternatives include using a different data analysis approach. Occupancy analysis produces abundance estimates from presence-absence data. It is a potential alternative that avoids some of the problems encountered in DISTANCE and does not require as much time and effort as distance methods (Royle and Nichols 2003). This alternative might be ideal for CBNP or any project where resources are limited, and the simpler protocol would allow a greater opportunity for spatial replication of counts and for the possibility of trained, volunteer birders conducting counts. The data collection procedures need not change if CBNP officials wish to explore occupancy analysis (although recording distance estimates can be eliminated, but distance analysis will no longer be an option). We recommend investigating occupancy analysis in program MARK (White and Burnham 1999) and exploring emerging literature for implementation guidelines (Royle and Nichols 2003, MacKenzie et al. 2006).

Alternative methods of data analysis, such as occupancy analysis, should be explored for avian monitoring programs such as this one. Other future research needs include a long-term continuation of this monitoring program throughout the entire area of the park. This research only sampled a small section of the park. Covering the entire area is necessary to accurately gauge tourism effects on a larger and more realistic scale. Areas of the park that will be susceptible to increased tourist use and development in the future should be considered. Observers should count on- and off-trail in the tourist sites to determine the maximum distance from the trail that any disturbances on the trails might be affecting birds. This monitoring methodology can be applied to different habitats within the park, although data from different habitat types should be analyzed separately. Because monitoring programs must evaluate long-term effects, all monitoring programs should be conducted for several years. Monitoring other types of wildlife and plant communities should be explored, as well as visitor use and intensity. There are a great deal of management actions CBNP can implement to address conservation concerns; monitoring programs such as this one will provide the necessary data and foundation needed to make sound resource management decisions.

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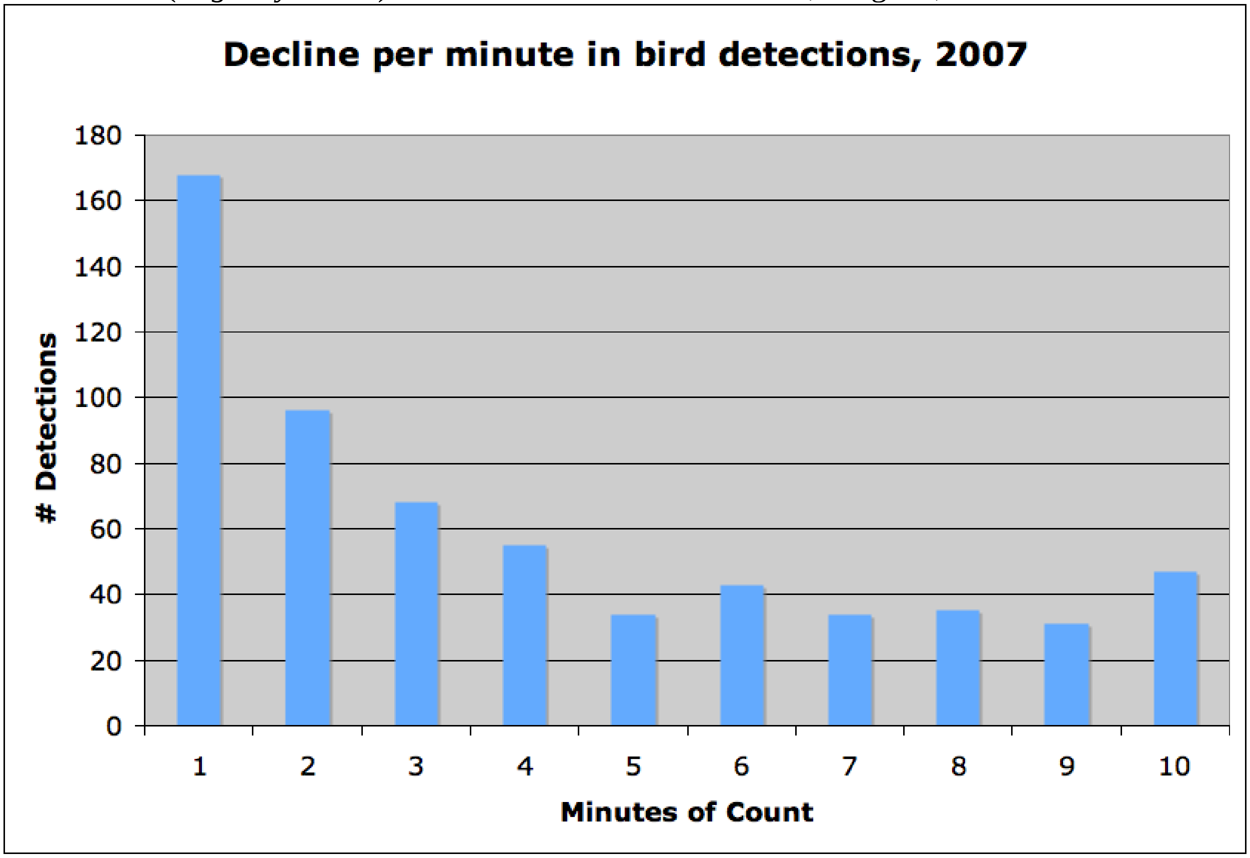
APPENDICES

APPENDIX A. Decline per minute in detections of birds observed during point counts within the beech forest (*Fagus sylvatica*) of Central Balkan National Park, Bulgaria, June 2007.



APPENDIX B. All bird species observed in Central Balkan National Park, Bulgaria, June 2007 and May 2008, listed alphabetically by common name.

Common Name	Scientific Name
Black Redstart	*Phoenicurus ochruros*
Black Woodpecker	*Dryocopus martius*
Blackbird	*Turdus merula*
Blue Tit	*Parus caeruleus*
Bullfinch	*Pyrrhula pyrrhula*
Buzzard	*Buteo buteo*
Chaffinch	*Fringilla coelebs*
Chiffchaff	*Phylloscopus collybita*
Coal Tit	*Parus ater*
Corn Bunting	*Miliaria calandra*
Cuckoo	*Cuculus canorus*
Dipper	*Cinclus cinclus*
Dunnock	*Prunella modularis*
Garden Warbler	*Sylvia borin*
Golden Eagle	*Aquila chrysaetos*
Golden Oriole	*Oriolus oriolus*
Goldfinch	*Carduelis carduelis*
Great Spotted Woodpecker	*Dendrocopos major*
Great Tit	*Parus major*
Green Woodpecker	*Picus viridis*
Greenfinch	*Carduelis chloris*
Grey Partridge	*Perdix perdix*
Grey Wagtail	*Motacilla cinerea*
Hoopoe	*Upupa epops*
Jay	*Garrulus glandarius*
Kestrel	*Falco tinnunculus*
Lesser Spotted Woodpecker	*Dendrocopos minor*
Lesser Whitethroat	*Sylvia curruca*
Linnet	*Carduelis cannabina*
Long-tailed Tit	*Aegithalos caudatus*
Magpie	*Pica pica*
Middle Spotted Woodpecker	*Dendrocopos medius*
Mistle Thrush	*Turdus viscivorus*
Northern Goshawk	*Accipiter gentilis*
Northern Hobby	*Falco subbuteo*
Nutcracker	*Nucifraga caryocatactes*
Nuthatch	*Sitta europaea*
Ortolan Bunting	*Emberiza hortulana*

APPENDIX B, cont. All bird species observed in Central Balkan National Park, Bulgaria, June 2007 and May 2008, listed alphabetically by common name.

Raven	*Corvus corax*
Red-backed Shrike	*Lanius collurio*
Red-breasted Flycatcher	*Ficedula parva*
Redstart	*Phoenicurus phoenicurus*
Robin	*Erithacus rubecula*
Rock Bunting	*Emberiza cia*
Short-toed Treecreeper	*Certhia brachydactyla*
Skylark	*Alauda arvensis*
Sombre Tit	*Poecile lugubris*
Song Thrush	*Turdus philomelos*
Spotted Flycatcher	*Muscicapa striata*
Starling	*Sturnus vulgaris*
Swift	*Apus apus*
Three-toed Woodpecker	*Picoides tridactylus*
Treecreeper	*Certhia familiaris*
Water Pipit	*Anthus spinoletta*
Wheatear	*Oenanthe oenanthe*
White Wagtail	*Motacilla alba*
White-backed Woodpecker	*Dendrocopos leucotos*
Wood Warbler	*Phylloscopus sibilatrix*
Woodlark	*Lullula arborea*
Woodpigeon	*Columba palumbus*
Wren	*Troglodytes troglodytes*
Wryneck	*Jynx torquilla*
Yellow Wagtail	*Motacilla flava*
Yellowhammer	*Emberiza citrinella*

APPENDIX C. All bird species observed in Central Balkan National Park, Bulgaria, June 2007 and May 2008, listed alphabetically by scientific name.

Scientific Name	Common Name
Accipiter gentilis	Northern Goshawk
Aegithalos caudatus	Long-tailed Tit
Alauda arvensis	Skylark
Anthus spinoletta	Water Pipit
Apus apus	Swift
Aquila chrysaetos	Golden Eagle
Buteo buteo	Buzzard
Carduelis cannabina	Linnet
Carduelis carduelis	Goldfinch
Carduelis chloris	Greenfinch
Certhia brachydactyla	Short-toed Treecreeper
Certhia familiaris	Treecreeper
Cinclus cinclus	Dipper
Columba palumbus	Woodpigeon
Corvus corax	Raven
Cuculus canorus	Cuckoo
Dendrocopos leucotos	White-backed Woodpecker
Dendrocopos major	Great Spotted Woodpecker
Dendrocopos medius	Middle Spotted Woodpecker
Dendrocopos minor	Lesser Spotted Woodpecker
Dryocopus martius	Black Woodpecker
Emberiza cia	Rock Bunting
Emberiza citrinella	Yellowhammer
Emberiza hortulana	Ortolan Bunting
Erithacus rubecula	Robin
Falco subbuteo	Northern Hobby
Falco tinnunculus	Kestrel
Ficedula parva	Red-breasted Flycatcher
Fringilla coelebs	Chaffinch
Garrulus glandarius	Jay
Jynx torquilla	Wryneck
Lanius collurio	Red-backed Shrike
Lullula arborea	Woodlark
Miliaria calandra	Corn Bunting
Motacilla alba	White Wagtail
Motacilla cinerea	Grey Wagtail
Motacilla flava	Yellow Wagtail
Muscicapa striata	Spotted Flycatcher

APPENDIX C, cont. All bird species observed in Central Balkan National Park, Bulgaria, June 2007 and May 2008, listed alphabetically by scientific name.

Nucifraga caryocatactes	Nutcracker
Oenanthe oenanthe	Wheatear
Oriolus oriolus	Golden Oriole
Parus ater	Coal Tit
Parus caeruleus	Blue Tit
Parus major	Great Tit
Perdix perdix	Grey Partridge
Phoenicurus ochruros	Black Redstart
Phoenicurus phoenicurus	Redstart
Phylloscopus collybita	Chiffchaff
Phylloscopus sibilatrix	Wood Warbler
Pica pica	Magpie
Picoides tridactylus	Three-toed Woodpecker
Picus viridis	Green Woodpecker
Poecile lugubris	Sombre Tit
Prunella modularis	Dunnock
Pyrrhula pyrrhula	Bullfinch
Sitta europaea	Nuthatch
Sturnus vulgaris	Starling
Sylvia borin	Garden Warbler
Sylvia curruca	Lesser Whitethroat
Troglodytes troglodytes	Wren
Turdus merula	Blackbird
Turdus philomelos	Song Thrush
Turdus viscivorus	Mistle Thrush
Upupa epops	Hoopoe