Effects of Habitat Patch Size on Occupancy and Reproductive Success of a Forest-Dependent Songbird in an Urban Landscape

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EXECUTIVE SUMMARY

Protecting large tracts (>100 ha) of land is suggested for area-sensitive species. However it is important to know the amount of habitat needed for a species to successfully reproduce, to correctly estimate management goals for habitat protection. Past research in a rural landscape has found a minimum patch size threshold for reproductive success in an area-sensitive species, the golden-cheeked warbler (*Setophaga chrysoparia*). However there has been no research on a reproductive threshold for this warbler in an urban landscape. I surveyed the Ulrich Water Treatment Plant to determine a minimum patch size threshold for territorial male occupancy, pairing success, and reproductive success in an urban landscape. There were no birds occupying this property, so no patch size thresholds were determined.

INTRODUCTION

There has been an increasing amount of research in the last thirty years on ecological thresholds, defined as a relatively rapid change occurring from one condition to another (Huggett 2005). This increase in research has occurred in part due to a growing amount of habitat loss and fragmentation. Habitat loss from urban, transportation, and agricultural development significantly threatens biodiversity (Collinge 1998, Miller & Cale 2000). Andrén (1994) determined that habitat fragmentation is often equal to habitat loss for a variety of birds and mammals. However Andrén (1994) also pointed out that landscape's with highly fragmented habitat display a compounded effect from patch size and isolation, and the loss of species or population decline will be greater with effects from habitat fragmentation and loss, than from habitat loss alone. Past research has found neotropical migrant birds decrease in diversity and abundance as adjacent development increased, and specifically forest-dwelling passerines were more abundant in habitat adjacent to lower density housing developments than higher density housing developments (Friesent *et al.* 1995, Kluza et al 2000). Radford *et al.* (2005) found strong evidence supporting a species-richness threshold response on a landscape level. Denoël and Ficetola (2007) found significant thresholds for landscape composition and configuration in 3 newt species (*Triturus alpestris, T. helveticus, T. vulgaris*), although these thresholds were highly variable across the species.

Most research on threshold levels in passerine systems has studied occupancy levels, rather than abundance or reproductive success (Donnelly and Marzluff 2004, Radford and Bennett 2004, Betts *et al.* 2007). Donnelly and Marzluff (2004) found lower species richness thresholds in smaller habitat patches. Radford and Bennett (2004) determined minimum occupancy thresholds in relation to patch isolation and amount of habitat for the white-browed treecreeper (*Climacteris affinis*). Betts *et al.* (2007) found significant occupancy thresholds for amount of habitat in 14 of 15 songbird species. Only two of the 15 species, the

black-throated blue warbler (*Dendroica caerulescens*) and the ovenbird (*Seiurus aurocapilla*), displayed a significant occupancy threshold in relation to minimum habitat patch size. Burke and Nol (2000) researched reproductive success for 4 forest-dwelling passerines, the ovenbird (*S. aurocapilla*), wood thrush (*Hylocichla mustelina*), rose-breasted grosbeak (*Pheucticus ludovicianus*), and veery (*Catharus fuscens*), and found lower reproductive success in smaller habitat patch fragments. However Burke and Nol (2000) did not determine any minimum patch size thresholds for these 4 passerines.

It is important, when establishing species-specific management goals, to know how much habitat a species needs to successfully reproduce. Wahl *et al.* (1990) and Beardmore *et al.* (1996) recommend protecting large tracts (>100 ha) of land for area-sensitive species. However, this recommendation does not specify species, and thus is not reliable across the animal kingdom. The golden-cheeked warbler (*Setophaga chrysoparia*), an area-sensitive, federally endangered, songbird (U.S. Fish and Wildlife Service 1990, Beardmore *et al.* 1996, Groce *et al.* 2010), has been monitored on many habitat patches ≥100 ha across Texas (Jette *et al.* 1998, Anders and Dearborn 2004, Cooksey and Edwards 2008, City of Austin 2009). However there have been few studies monitoring the golden-cheeked warbler in habitat patches <100 ha (Benson 1990, Arnold *et al.* 1996, Butcher *et al.* 2010). Benson (1990) found golden-cheeked warblers occupying patches as small as 0.66 ha. Arnold *et al.* (1996) found the golden-cheeked warbler consistently occupied patches >23 ha, although some birds were found in patches as small as 6.5 ha. Butcher *et al.* (2010) found a minimum patch size threshold for golden-cheeked warbler reproductive success between 15 and 20 ha in a rural landscape in east-central Texas. There have been no other studies looking at golden-cheeked warbler minimum patch size threshold.

The breeding range of the golden-cheeked warbler encompasses large amounts of urban and rural landscapes throughout Texas. This warbler was originally listed in part due to the assumption that 67% of the breeding population occurred in counties on the eastern Edwards Plateau, where large amounts of urban development exists, and development continues to increase (Groce *et al.* 2010). Across the breeding range, human population rates and building permit activity continues to increase (Groce *et al.* 2010). Sperry (2007) compared different land use types adjacent to habitat patches, and found habitat patches adjacent to housing developments had the lowest golden-cheeked warbler occupancy, in comparison to a habitat patches adjacent to utility easements and woodland meadows. Occupancy of neotropical migrants declines as distance to urban development decreases (Friesen *et al.* 1995, Kluza *et al.* 2000), and productivity of forest-dwelling passerines declines in smaller habitat patches, common in urban areas (Burkes and Nol 2000). Research on golden-cheeked warblers has shown similar declines near development and smaller habitat fragments. Maas (1998) found reproductive success of golden-cheeked warblers decreased with increased habitat fragmentation. Coldren (1998) found a decrease in golden-cheeked warbler reproductive success as distance to the edge of a habitat patch decreased, and low occupancy in patches near urban areas.

We determined the minimum patch size threshold for golden-cheeked warbler reproductive success in urban areas. We used territorial male occupancy, male territory establishment, pairing success, territory success, and number of fledglings as different forms of reproductive activity. We used Butcher *et al.* (2010) to compare minimum patch size threshold differences between urban and rural landscapes. Andrén (1994) found that landscapes with highly fragmented habitat display a compounded effect from patch size and isolation. This added habitat fragmentation often results in loss of species, or a more substantial decline in population than would be expected in a habitat patch with less fragmentation. We compared urban habitat patch results to the rural habitat patch results of Butcher *et al.* (2010), in an effort to distinguish between rural and urban area requirements for warblers. This will allow for more effective management of potential habitat patches, based on level of habitat fragmentation and surrounding land use.

METHODS

We conducted this study on the Ulrich Water Treatment Plant property, hereafter Ulrich (Figure 1), as well as a number of different private lands surrounding Austin, TX. We determined warbler occupancy, defined as at least one male located in the potential habitat patch, by visiting the patch six times (MacKenzie and Royle 2005, Collier *et al.* 2010), with seven days between each visit. We walked transects ~200 m apart, and marked GPS points for locations of all individual golden-cheeked warblers. If a golden-cheeked warbler was not located after six visits over a six week time period, we considered the patch unoccupied, and visits were terminated.

RESULTS AND CONCLUSION

We visited Ulrich six times over six different weeks, between 17 March and 21 April, 2011. During these six visits, we did not locate any singing golden-cheeked warblers on the property. Because there was so few study sites associated with this project, we did not conduct an analysis of warbler occupancy relative to potential habitat patch size. Additional surveys will be conducted during 2012 across the Austin, Texas area to gather more information on warbler minimum patch size thresholds in an urban landscape.

LITERATURE CITED

Anders, A. D., and D. C. Dearborn. 2004. Population trends of the endangered golden-cheeked warbler at Fort Hood, Texas, from 1992–2001. The Southwestern Naturalist 49:39–47.

Andrén, H. 1994. Effects of habitat fragmentation on birds and mammal in landscapes with different proportions of suitable habitat: a review. Oikos 71:355-366.

Arnold, K. A., C. L. Coldren, and M. L. Fink. 1996. The interactions between avian predators and golden-cheeked warblers in Travis County, Texas. Texas Transportation Institute. Texas A&M University. College Station, Texas, USA.

Beardmore, C. J., J. Hartfield, and J. Lewis, editors. 1996. Golden-cheeked warbler population and habitat viability assessment report. U.S. Fish and Wildlife Service, Austin, Texas, USA.

Benson, R. H. 1990. Habitat area requirements of the golden-cheeked warbler on the Edwards Plateau. Texas Parks and Wildlife Department, Austin, Texas, USA.

Betts, M. G, J. G. Forbes, and A. W. Diamond. 2007. Thresholds in songbird occurrence in relation to landscape structure. Conservation Biology 21:1046-1058.

Burke, D. M. and E. Nol. 2000. Landscape and fragment size effects of forest-breeding birds in Ontario. Ecological Applications 10:1749-1761.

Butcher, J. A., M. L. Morrison, D. Ransom Jr., R. D. Slack, and R. N. Wilkins. 2010. Evidence of a minimum patch size threshold of reproductive success in an endangered songbird. Journal of Wildlife Management 74:133-139.

Christoferson, L. L., and M. L. Morrison. 2001. Integrating methods to determine breeding and nesting status of 3 western songbirds. Wildlife Society Bulletin 29:688-696.

City of Austin. 2009. Golden-cheeked warbler (*Dendroica chrysoparia*) and black-capped vireo (*Vireo atricapilla*) monitoring program. Balcones Canyonlands Preserve Annual Report, Fiscal year 2008-09. City of Austin Water Utility, Wildland Conservation Division, and Balcones Canyonlands Preserve Program.

Coldren, C. L. 1998. The effects of habitat fragmentation on the golden-cheeked warbler. Dissertation, Texas A&M University, College Station, Texas, USA.

Collier, B. A., M. L. Morrison, S. L. Farrell, A. J. Campomizzi, J. A. Butcher, K. B. Hays, D. I. MacKenzie, R. N. Wilkins. 2010. Monitoring golden-cheeked warblers on private lands in Texas. Journal of Wildlife Management 74:140-147.

Collinge, S. K. 1998. Spatial arrangement of habitat patches and corridors: Clues from ecological Weld experiments. Landscape and Urban Planning 42:157-168.

Cooksey, M. L., and S. M. Edwards. 2008. Monitoring of the golden-cheeked warbler and the black-capped vireo on Camp Bullis, Texas: 2008 field season report. Fort Sam Houston.

DeBoer, T. S. and D. D. Diamond. 2006. Predicting presence-absence of the endangered golden-cheeked warbler (*Dendroica chrysoparia*). Southwestern Naturalist 51:181-190.

Denoël, M., and G. F. Ficetola. 2007. Landscape-level thresholds and newt conservation. Ecological Applications 17:302-309.

Donnelly, R. and J. M. Marzluff. 2004. Importance of reserve size and landscape context to urban bird conservation. Conservation Biology 18:733-745.

Friesen, L. E., P. F. J. Eagles, and R. J. Mackay. 1995. Effects of residential development on forest-dwelling neotropical migrant songbirds. Conservation Biology 9:1408-1414.

Gass, L. R. 1996. Nesting behavior of golden-cheeked warblers in Travis county, Texas. Thesis, Southwestern Texas State University, Austin, Texas, USA.

Groce, J. E., H. A. Mathewson, M. L. Morrison, and R. N. Wilkins. 2010. Scientific Evaluation for the 5-year status review of the golden-cheeked warbler. Texas A&M Institute of Renewable Natural Resources, College Station, Texas, USA.

Heilbrun, R. D., N. Lake, A. Arnold, and D. Hisler. 2009. Habitat suitability model for evaluating City of San Antonio land donation for golden-cheeked warblers. Texas Parks & Wildlife Department PWD W7000-1685. Austin, Texas, USA.

Homer C., J. Dewitz, J. Fry, M. Coan, N. Hossain, C. Larson, N. Harold, A. McKerrow, J. N. VanDriel, and J. Wickham. 2007. Completion of the 2001 National Land Cover Database for the conterminous United States. Photogrammetric Engineering and Remote Sensing 73:337-341.

Huggett, A. J. 2005. The concept and utility of 'ecological thresholds' in biodiversity conservation. Biological Conservation 124:301-310.

Jette, L. A., T. J. Hayden, and J. D. Cornelius. 1998. Demographics of the golden-cheeked warbler (*Dendroica chrysoparia*) on Fort Hood, Texas. U.S. Army Corps of Engineers Technical Report 98/52.

Kluza, D. A., C. R. Griffin, and R. M. DeGraaf. 2000. Housing developments in rural New England: effects on forest birds. Animal Conservation 3:15-26.

Ladd, C. G., and L. Gass. 1999. Golden-cheeked warbler (Dendroica chrysoparia). Account 420 *in* A. Poole, editor. The Birds of North America online. Cornell Lab of Ornithology, Ithaca, New York, USA.

Maas, D. S. 1998. Factors influencing demographics of golden-cheeked warblers (*Dendroica chrysoparia*) at Fort Hood Military Reservation, Texas. Thesis, University of Oklahoma, Norman, Oklahoma, USA.

MacKenzie, D. I., and J. A. Royle. 2005. Designing occupancy studies: general advice and allocating survey effort. Journal of Applied Ecolgy 42:1105-1114.

MacKenzie, D. I., J. D. Nichols, J. A. Royle, K. H. Pollock, L. L. Bailey, and J. E. Hines. 2006 Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence. Academic Press, San Diego.

Magness, D. R., R. N. Wilkins, and S. J. Hejl. 2006. Quantitative relationships among golden-cheeked warbler occurrence and landscape size, composition, and structure. Wildlife Society Bulletin 34:473-479.

Marzluff, J. M, and E. Neatherlin. 2006. Corvid response to human settlements and campgrounds: Causes, consequences and challenges for conservation. Biological Conservation 130:301-314.

Miller, J. R. and P. Cale. 2000. Behavioral mechanisms and habitat use by birds in a fragmented agricultural landscape. Ecological Applications 10:1732-1748.

Morrison, M. L., R. N. Wilkins, B. A. Collier, J. E. Groce, H. A. Mathewson, T. M. McFarland, A. G. Snelgrove, R. T. Snelgrove, and K. L. Skow. 2010. Golden-cheeked warbler population distribution and abundance. Texas A&M Institute of Renewable Natural Resources, College Station, Texas, USA.

Nichols, J. D., J. E. Hines, J. R. Sauer, F. W. Fallon, J. E. Fallon, and P. J. Heglund. 2000. A double-observer approach for estimating detection probability and abundance from point counts. Auk 117:393-408.

Pulich, W. M. 1976. The golden-cheeked warbler: A bioecological study. Texas Parks and Wildlife Department. Austin, Texas, USA.

Radford J. Q., and A. F. Bennett. 2004. Thresholds in landscape parameters: occurrence of the white-browed treecreeper *Climacteris affinis* in Victoria, Australia. Biological Conservation 117:375-391.

Radford, J. Q., A. F. Bennett, and G. J. Cheers. 2005. Landscape-level thresholds of habitat cover for woodland-dependent birds. Biological Conservation 124:317-337.

Reemts, C. M., C. Picinich, D. Cimprich, and R. G. Peak. 2008. Vegetation studies of black-capped vireo and golden-cheeked warbler habitat. Chapter 9 *in* Endangered species monitoring and management at Fort Hood, Texas: 2008 annual report. The Nature Conservancy, Fort Hood Project, Fort Hood, Texas, USA.

Sillett, T. S., N. L. Rodenhouse, and R. T. Holmes. 2004. Experimentally reducing neighbor density affects reproduction and behavior of a migratory songbird. Ecology 85:2467-2477.

Sperry, C. Influences of borders on golden-cheeked warbler habitat in the Balcones Canyonlands Preserve, Travis county, Texas. Thesis, Texas State University, San Marcos, Texas, USA.

U.S. Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants; emergency rule to list the golden-cheeked warbler as endangered. Federal Register 55:18844-18845.

Vickery, P. D., M. L. Hunter, Jr., and J. V. Wells. 1992. Use of reproductive index to evaluate relationships between habitat quality and breeding success. Auk 109:697-705.

Wahl, R., D. D. Diamond, and C. D. Duncan. 1990. The golden-cheeked warbler: a status review. U.S. Fish and Wildlife Service, Ecological Services, Fort Worth, Texas, USA.

Figure 1: Ulrich Water Treatment Plant (green polygon) in Austin, TX. All undeveloped property surveyed.