Assessing the connectivity of the White-breasted Thrasher (*Ramphocinclus brachyurus*) populations

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Project report to the Nuttall Ornithological Club Blake-Nuttall Fund

SUMMARY

The White-breasted Thrasher (*Ramphocinclus brachyurus*; WBTH) is restricted to three populations, two on St. Lucia and one on Martinique. The St. Lucian and Martinique populations are separated by ~80 km. The two St. Lucian populations (Northeast and Mandelé) are separated by only 4 km. Little is known about movement of individuals between these three areas; none of the ~500 birds banded in the St. Lucian Mandelé range have been resighted in the other two thrasher populations, though resighting was not the goal of past WBTH work. Evidence from field surveys of banded birds in 2013 suggests that these separate populations might be completely isolated, even those separated by only 4 km – this might be due in part to the intervening matrix of human development and agriculture acting as a barrier to dispersal. In addition to banding records, our research provides a separate method for determining the degree to which populations are isolated by using genetic methods that compare allele frequencies. To do this, we collected blood samples. With these samples, we can assess overall genetic structure, genetic diversity within each population, and number of migrants between populations. Ultimately, these measures will tell us the extent to which each population is reproductively isolated. This genetic work is to be completed in 2014.

Our research will inform conservation managers by:

1. Providing information on whether the three WBTH populations should be managed as a single population, as separate populations, or as a metapopulation.
2. Providing input on forest restoration projects and reserve placement – in particular, is it important to connect the populations (if genetic data suggest recent connectivity that is no longer being observed).
3. Providing information on the potential efficacy of animal translocations – one might not want to mix genetically distinct populations.
4. Using population connectivity information to build more accurate population viability models.

PROJECT RATIONALE

The White-breasted Thrasher is a non-migratory endangered cooperatively breeding songbird endemic to the Caribbean islands of St. Lucia and Martinique (BirdLife International 2013). On Martinique ~300 adults are located on the Caravelle Peninsula. The St. Lucian WBTH is restricted to two populations, Northeast (~150 adults) and Mandelé (~1500 adults), on the east coast of the island (Temple 2005). The Northeast subpopulation of approximately 100 adults is ten-fold smaller than Mandelé and has experienced a 50% decline over the past 30 years. While loss of dry forest habitat is implicated in the historic decline of the Mandelé population, the cause of the continuing Northeast decline is unclear. WBTH in both St. Lucian populations are facing further threats: in 2006, 13.5% of the Mandelé range was destroyed to build a golf and beach resort, and large parcels of the Northeast range were recently sold to developers (Mortensen 2009, Young et al. 2010).

Because the WBTH is an endangered species, one of our research aims is to perform a quantitative assessment of extinction risk (population viability analysis). We will accomplish this using a stochastic simulation model, with parameters informed by field work. To create a biologically realistic model, we needed to determine vital rates and connectivity of the WBTH populations; we had some information on the former (though fieldwork supported in part by the 2012 Blake-Nuttall Fund), but little on the latter.

The degree of population connectivity in a fragmented landscape is an important determinant of persistence (e.g., Akçakaya 2001). Some bird species, particularly in the tropics, exhibit short dispersal distances and dispersal can be inhibited readily by non-habitat (Mayr 1965, Laurance et al. 2004); short dispersal distances also characterize cooperatively breeding birds (Koenig et al.1992). In addition, contemporary landscapes often contain barriers to dispersal, e.g. roads and other human development, thereby disrupting flow of individuals between previously connected populations (Shepard et al. 2008, Thinh et al. 2012). One way disrupted dispersal impacts population persistence is by eliminating rescue if the population begins to decline (Pulliam & Danielson 1991). Disrupted dispersal also disrupts gene flow, contributing to loss of genetic variation (Frankham 2002), and contributing to one extinction vortex. Hence, understanding connectivity is important to assessing extinction risk

The St. Lucian and Martinique WBTH populations are separated by ~80 km. While the two St. Lucian WBTH populations (Northeast and Mandelé) are separated by only 4 km, the intervening matrix of human development and agriculture may be a barrier to the species' typically short-distance dispersal, which is measured in hundreds of meters (Temple 2005). **Consequently, the objective of this work was to determine if individuals were dispersing among the three populations. To evaluate this we use (1) field surveys to determine if WBTHs we banded in Mandelé dispersed to the Northeast or to Martinique and (2) molecular methods (microsatellites) to identify extent of gene flow.** Banding and molecular methods are complementary approaches to assessing population connectivity. Methods that rely on banding are a direct assessment of successful dispersal and molecular methods assess breeding of dispersers by quantifying gene flow.

2013 ACCOMPLISHMENTS

***Field surveys* – We searched eight river valleys in the Northeast range during our 2013 field season** – Bois Joli, Lumiére, Fond D'or, Anse Povert, Louvet, Caille Des, Anse La Chaloupe, and Grand Anse (Fig. 1). Our approach consisted of team members walking parallel transects away from the river valley. WBTHs are inquisitive birds and respond to conspecific playback, so we stopped approximately every 50 m and used a speaker to draw in birds. **In > 100 hours of searching, we saw zero banded WBTHs in the Northeast.** This is despite >575 WBTHs individually color-banded in the Mandelé range since 2002 (Temple 2005, Mortensen 2009, Mortensen unpubl. data). WBTHs were last banded in Martinique in the early 1990's (Thierry et al. 2013). WBTH longevity is poorly documented, but birds are known to live at least 10 years. **However, we sighted and got GPS locations of 36 unbanded WBTHs in the Northeast**. These data suggest that individuals are not moving between the Northeast and Mandelé.

***Molecular methods* – We found 8 active WBTH nests while searching for birds in the Northeast** (Fig. 2). There were an additional 4 nests at which we attempted to capture the resident birds and failed. We found many more non-active (i.e., nests that fledged or failed earlier in the season) than active nests. However, we did not attempt to mist-net at these locations because resident birds were no longer motivated to visit the nest.

We banded 15 birds (14 adults and 1 chick) at the 8 active nests. At 6 of these nests we captured the breeding pair, and each pair were after-second-year birds (i.e. ≥ 2 years old). There was no evidence of cooperative breeding at any of the nests. We collected ~ 50ul blood from each individual according to standard field protocol (Gaunt & Oring 2010) and stored samples on Whatman FTA cards for later DNA extraction and genotyping. We conducted fieldwork in St. Lucia with the approval of the St. Lucia Forestry Department and under IACUC Protocol #M2009-66 A-1 from Tufts University.

ONGOING WORK

We will determine effective dispersal between populations via genetic methods that compare allele frequencies (see Statistical packages below; Selkoe & Toonen 2006, Broquet & Petit 2009). To do this, we will compare blood samples collected from WBTHs in the Northeast (samples collected in 2013; n = 15), Mandelé (samples collected in 2011-2013; n = 60), and Martinique (samples to be collected in May of 2014). We will process the blood samples in June of 2014, which will include DNA extraction, PCR amplification with fluorescently-labeled primers, and genotyping using six microsatellite loci developed for the WBTH (Jin et al. 2006). In the Mandelé range, these loci average 5.33 alleles and an observed heterozygosity of 0.60 (Temple 2006); nothing is known about genetic structure of the Northeast and Martinique populations. Microsatellites are appropriate molecular markers for this proposed work because they allow determination of contemporary migration estimates over a medium temporal scale (Selkoe & Toonen 2006, Finger & Klank 2010). We will send our samples to the University of Chicago Comprehensive Cancer Center DNA Sequencing & Genotyping Facility for genotyping. We will amplify and genotype ~5% of our samples twice to estimate the frequency of genotyping scoring error rate (Selkoe & Toonen 2006). Genotypes will be scored manually.

We will assess genetic structure of the St. Lucian WBTH using several software packages, including GENEPOP (Raymond & Rousset 1995) and FSTAT (Goudet 2001) to evaluate genetic diversity analyses and STRUCTURE (Pritchard et al. 2000) to estimate the # of subpopulations in our sample. Measures of genetic variation will include # of alleles, allelic richness, and expected heterozygosity (Goudet 2001). To calculate genetic variation across populations, we will assess # of private alleles with GENALEX (Peakall & Smouse 2006) and use FSTAT to create a matrix of pair-wise F_{ST} values. We will use GENEPOP (Raymond & Rousset 1995) to estimate the effective number of migrants between populations. Private alleles in each population and high F_{ST} values will be evidence of disruption of gene flow. We will use an exact test to determine whether population differentiation differs significantly from zero.

We will send results of these analysis once they are completed.

ACKNOWLEDGMENTS

- Support in St. Lucia – St. Lucia Forestry Department, including Mr. Michael Bobb, Mr. Adams Toussaint, Mr. Alwin Dornelly, Mr. Lyndon John, Mr. Lenn Isidore, Ms. Mary James, and Mr. Stephen Lesmond; Matt Morton of Durrell Wildlife Conservation Trust; Kierron Dolby and Peter Ernest of DCG Construction Properties
- Field team – Gunnar Kramer, Stephen Lesmond, Stephan Lesmond, and Lenn Isidore
- Reed-Romero Lab Members of Tufts University
- Funding – National Science Foundation, Ornithological Council, P.E.O., Tufts Office of Graduate Studies, and Nuttall Ornithological Club Blake-Nuttall Fund

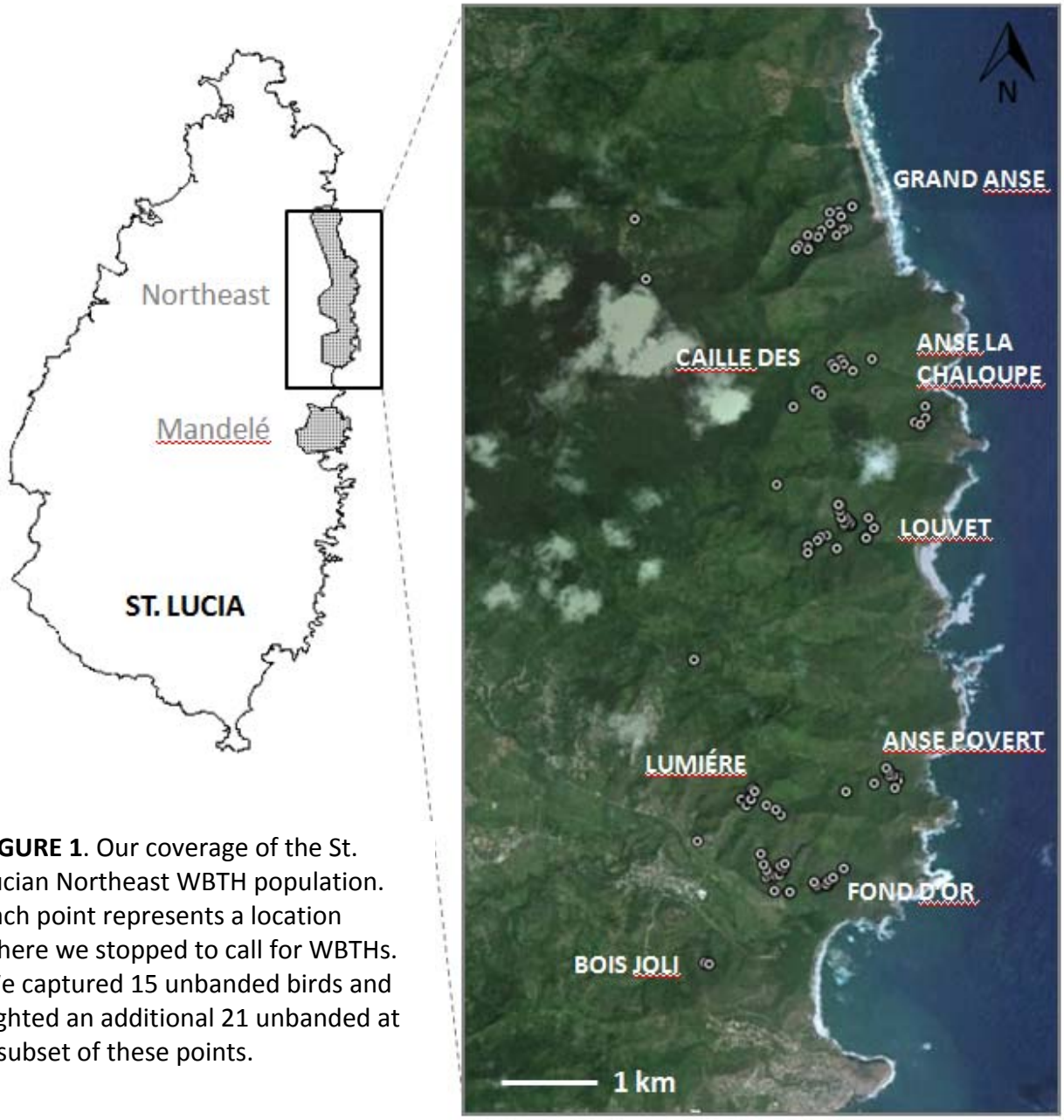

FIGURE 1. Our coverage of the St. Lucian Northeast WBTH population. Each point represents a location where we stopped to call for WBTHs. We captured 15 unbanded birds and sighted an additional 21 unbanded at a subset of these points.

FIGURE 2. *A*. Typical WBTH nest in the crown of a small sapling. *B*. Open-cup of WBTH nest containing a complete clutch of two eggs. *C*. Adult WBTH banded in Mandelé (photo by Gunnar Kramer).

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