

ABSTRACT

Title of Document: CRYPTIC GENETIC INTROGRESSION INTO
AN APPALACHIAN SKY ISLAND
POPULATION OF BLACK-CAPPED
CHICKADEES (*POECILE ATRICAPILLUS*)

Brian Davidson, Master of Science, 2011

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Black-capped chickadees (*Poecile atricapillus*) hybridize with Carolina chickadees (*P. carolinensis*) along the species' contact zone across the eastern United States and in the northern Appalachian Mountains. The Great Smoky Mountains harbor the last large breeding population of *atricapillus* in the southern Appalachians, isolated from the species main range by nearly 200 km. This population is believed to be reproductively isolated from local *carolinensis* due to a behaviorally-mediated elevational range gap during the breeding season, which may function as an incipient speciation mechanism. I characterized this population genetically, using hundreds of AFLP loci spread throughout the genome as well as cytochrome-b sequence data from the mitochondrial DNA. The Great Smoky Mountain population of *atricapillus*

has experienced genetic introgression from *carolinensis*, but at a much lower level than other populations near the northern hybrid zone. This population is also differentiated from northern conspecifics, likely due to historically reduced gene flow.

CRYPTIC GENETIC INTROGRESSION INTO AN APPALACHIAN SKY
ISLAND POPULATION OF BLACK-CAPPED CHICKADEES (*POECILE*
ATRICAPILLUS)

By

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Dedication

I dedicate this thesis to my loving wife, Elizabeth, without whose support this degree would not have been possible. Thanks for keeping me sane, keeping me happy, and being my girl. I love you!

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Chapter 1: Introduction

Section 1 Isolated Populations as Natural Experiments

Population isolation results from changes in the geographic range of a species. Range expansion is driven by the colonization of previously unoccupied habitat patches, while range contraction can isolate peripheral populations into ‘islands’ separate from the main range (‘mainland’). Such peripheral isolates can act as natural laboratories for evolutionary processes because they may experience different ecological and evolutionary pressures than populations in the species’ main range. While individual populations within a larger metapopulation often differ from one another, geographically isolated populations in particular are released from the homogenizing effects of gene flow and are able to take unique evolutionary trajectories. As with all populations, the genetic composition of geographic isolates differs depending upon a number of factors, such as the age of the population, local adaptation, genetic novelty, drift, and genetic exchange with nearby populations. Geographically isolated populations in particular may preserve these differences over time due to their unique history, especially if gene flow from the main range is low or absent.

The evolution and ecology of peripherally isolated populations may also be influenced by interactions with parapatric species along contact zones, where related species geographical distributions abut, and hybridization may occur (Barton and Hewitt 1985). Moving contact zones, in which one species expands its range at the expense of another (see review in Buggs 2007), either result in replacement or

assimilation of the species whose range retracts, depending on the frequency of hybridization and genetic introgression (Rhymer and Simberloff 1996, Mallet 2005). The formation of peripherally isolated populations may be facilitated by the presence of habitat mosaics, or differential rates of hybrid zone movement. These represent special cases of range boundary dynamics.

Comparisons between peripheral and main range populations of a species can help elucidate the ecological, environmental, and population genetic processes that shape the organism's responses to life at its range boundary. Here I assess the evolutionary status of an isolated population of Black-capped chickadees (*Poecile atricapillus*) in the Great Smoky Mountains (GSM), the highest range in the southern Appalachians, and look for genetic evidence of introgression from Carolina chickadees (*P. carolinensis*) at their range interface.

Section 2 Background on *P. atricapillus* and *P. carolinensis*

P. atricapillus are small non-migratory songbirds that are found throughout northern North America from New Jersey west to Kansas, north into Canada and Alaska, and south in the Rocky Mountains to northern New Mexico. Like many northern taxa, the range of *atricapillus* includes a southern salient through the Appalachian Mountains. In this region, the species' continuous range extends as far south as southern West Virginia, with scattered populations found on sky islands further south (see Figure 1). In the southern Appalachians, *atricapillus* are only found at high elevations that support Red Spruce (*Picea rubens*)/ Fraser Fir (*Abies fraseri*)/ Yellow Birch (*Betula alleghaniensis*) ecosystems. These sky island communities are widely scattered in the Blue Ridge province and have long been

subject to anthropogenic habitat disturbance, causing the local extinction of several *atricapillus* populations within the last century (Lee 1999). The only remaining large population of *atricapillus* in the southern Appalachians is in the Great Smoky Mountains National Park in Tennessee and North Carolina. Today, this sky island population is separated from the species' main range by nearly 200 km of marginal or unsuitable habitat, making it probable that the level of genetic exchange between the GSM and main range populations is at most very low. This southernmost *atricapillus* population may be a relict from the last glacial maximum or derive from post-glacial range expansion and colonization.

Due to its small geographic range, and restrictive habitat requirements, *atricapillus* is considered a species of concern in both Tennessee and North Carolina. Hunter et al. (1999) identify *atricapillus* as the southern Appalachian bird species most likely to become extirpated due to habitat destruction and the least likely to become reestablished in suitable but unoccupied habitat. Although protected by the national park, the GSM population is at risk of sharing the fate of other extirpated Appalachian bird populations due to habitat loss caused by invasive insects (Tingley et al. 2002, Simons et al. 2002) or climate change (Thomas and Lennon 1999, Inouye et al. 2000, Crick 2004).

In addition, southern Appalachian *atricapillus* are under threat of ecological replacement or genetic assimilation by the more southerly distributed, morphologically similar congener *Poecile carolinensis*. Extensive hybridization between *atricapillus* and *carolinensis* has been documented at the main range interface in the Midwest (Brewer 1963, Rising 1968, Merritt 1978, Robbins et al.

1986, Bronson et al. 2003a, Olson et al. 2010), Northeast (Curry 2005, Reudink et al. 2007), and in the northern Appalachians (Sattler and Braun 2000, Sattler et al. 2007). Each Appalachian sky island left vacant by extirpated *atricapillus* populations in the past 100 years has been colonized by *P. carolinensis* (Tanner 1952, Lee 1999), but it is unknown whether the *atricapillus* populations were replaced by or assimilated into expanding *P. carolinensis* populations.

In contrast to the main range contact zone between the species, hybridization between *atricapillus* and *carolinensis* has not been observed in the GSM (Tanner 1952, Tove 1980). Although the two forms occur together in winter flocks, a well-documented gap in their elevational distributions forms before the breeding season (Tanner 1952, Tove 1980), and has been implicated as a reproductive isolating mechanism. This gap in breeding distribution develops during early April, when *carolinensis* begin nesting below 900 m and *atricapillus* move upslope to the remaining spruce/fir forests above 1150 m. This distance is equivalent to at least 1.6 km horizontally, depending on slope (Tanner 1952). After the breeding season, the gap disappears as *atricapillus* move back downslope. The reason this elevational gap occurs is unknown, but *carolinensis* can be found breeding at elevations over 1800m on nearby mountains where *atricapillus* are absent (Tanner 1952, Simpson 1992), suggesting that the gap is mediated by interspecific interactions rather than a difference in breeding habitat preferences. Tanner (1952) and Tove (1980) concluded that the GSM population of *atricapillus* did not hybridize with local *carolinensis* based on the lack of morphological and vocal admixture, respectively. However, more recent studies in the northern Appalachians have established that morphology

and vocalizations are not as reliable for differentiating these species or identifying hybrids as molecular methods (Sattler and Braun 2000, Sattler et al. 2007). Although the GSM *atricapillus* population surely has very little, if any, genetic contact with conspecifics from the main range, levels of genetic exchange with local *carolinensis* remain unknown.

Section 3 Overview of present study

All studied populations of *atricapillus* near the main range contact zone with *carolinensis* have been shown to be heavily introgressed at the molecular level (Robbins et al. 1986, Sawaya 1990, Sattler and Braun 2000, Bronson et al. 2003a, Curry 2005, Reudink 2007, Sattler et al. 2007, Olson et al. 2010), even though extensive hybridization was not always suspected in advance. Thus, if the conclusions of Tanner (1952) and Tove (1980) regarding absence of hybridization are correct, the Great Smoky Mountains population of *atricapillus* would be unique in its purity. The goals in the present study were to determine 1) whether this last large *atricapillus* population in the southern Appalachians is genetically typical of pure, main range *atricapillus*, or if it has diverged; and 2) if divergent, whether that divergence is due to local differentiation, introgression from *carolinensis*, or both sources.

Previous studies on introgression between these species have focused on detecting hybridization or assessing introgression using a relatively low number of highly differentiated molecular markers. Markers that are highly differentiated or diagnostic between parental populations (such as mtDNA in chickadees) have often been used to detect admixture, but may underestimate cryptic introgression due to selection (Yuri et al. 2009). Gene exchange can also vary dramatically among loci

(Via and West 2008). Neutral markers are able to introgress more freely, but many are needed to obtain a quantitative measure of genome-level introgression or differentiation. I chose to perform this study using a relatively large number of nuclear amplified fragment length polymorphism (AFLP) loci as well as mitochondrial cytochrome-b sequence data. AFLP loci have several advantages over other marker types: They are largely neutral, being randomly generated from the whole genome, they require no prior sequence knowledge, they have high reproducibility and hundreds of loci can readily be studied in order to provide an approximation of genome-wide variation (Bensch and Åkesson 2005).

Chapter 2: Methods

Section 1 Sampling

The sampling design for this study comprises seven chickadee populations (Figure 1, Table 1). The focal population of *P. atricapillus* was sampled in the Great Smoky Mountains National Park (GSM). All these samples were taken from areas greater than 1500 m in elevation during the breeding season (29 May- 27 June) of 2009 to minimize the possibility of sampling transient *P. carolinensis* (Tanner 1952, Simpson 1992). This area contains the largest extant population of *atricapillus* in the southern Appalachians, perhaps the only self-sustaining one, and provided the best location to sample southern Appalachian *atricapillus*. Due to conservation

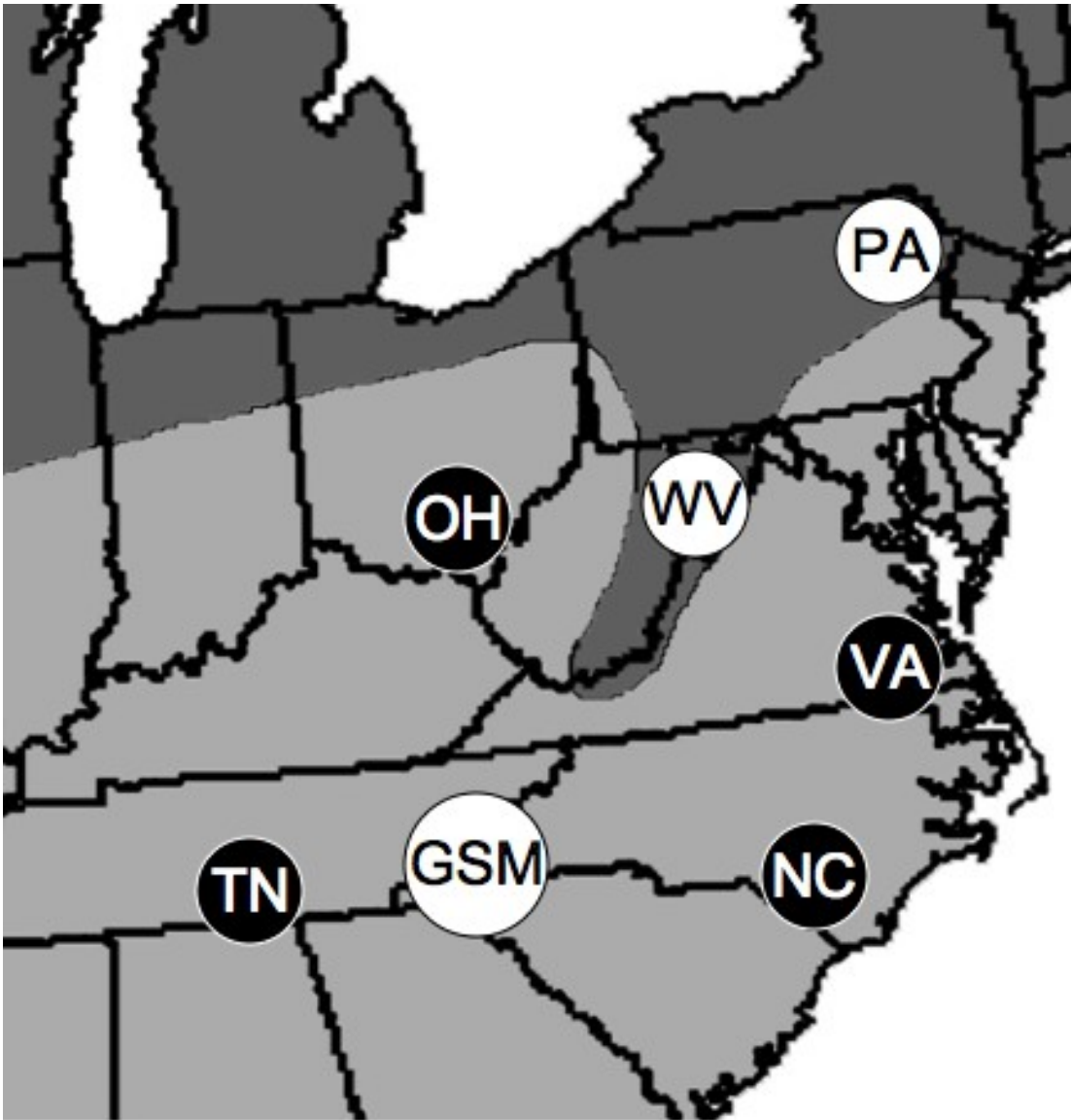


Figure 1. Geographic population sampling. The Great Smoky Mountain *atricapillus* population (GSM) was compared genetically with two *atricapillus* populations from the northern Appalachians (WV) and Pennsylvania (PA), and with four *carolinensis* populations (OH, VA, NC and TN) that flanked the two Appalachian *atricapillus* populations. White circles- *P. atricapillus*; black circles- *P. carolinensis*.

Table 1. Population sampling. Louisiana samples were collected by M. Braun (Braun and Robbins 1986). West Virginia, Virginia, Ohio, and Pennsylvania were collected by G. Sattler (Sattler and Braun 2000). All specimen numbers are NMNH (USNM) tissue numbers.

Population	Sample Size	Date	Coordinates	Tissue Numbers
Louisiana (LA)	3			B125, B126, B128
West Virginia (WV)	20	1990	38.90 N 79.25 W	B127, B1636- B1654
Virginia (VA)	21	1991	37.33 N 77.85 W	B2166- B2186
Ohio (OH)	20	1991	38.72 N 82.57 W	B2187- B2206
Pennsylvania (PA)	20	1991	41.52 N 77.65 W	B2207- B2226
Great Smoky Mountains (GSM)	30	29 May- 27 June 2009	35.60 N 83.45 W	B28978- B29007
North Carolina (NC)	30	10 Oct- 13 Oct 2009	35.00 N 79.50 W	B29010- B29039
Tennessee (TN)	30	17 Oct- 18 Oct 2009	35.70 N 85.25 W	B29040- B29069

concerns, individuals in this population were mist-netted using song playback, measured, banded, photographed, bled, and released. Blood was obtained by brachial vein puncture with a 26-gauge needle and 50-100 uL was preserved in the field using lysis buffer (Longmire et al. 1997). Two additional *atricapillus* population samples were used to represent main range parentals: a sample from the northern Appalachian peninsular range of the species in West Virginia (WV), and a sample from Pennsylvania (PA), distantly allopatric from the hybrid zone with *carolinensis*. Both were previously described by Sattler and Braun (2000).

Four populations of *P. carolinensis* were sampled: Ohio (OH) and Virginia (VA) previously collected by Sattler and Braun (2000), and newly collected populations from North Carolina (NC) and Tennessee (TN) (Figure 1, Table 1). Locations for sampled *carolinensis* populations were chosen to represent potential sources for introgression into Appalachian *atricapillus* populations. Samples NC and TN were collected by shotgun and tissue samples frozen in the field. Specimens were measured in the field and will be prepared as study skins for deposit at the Smithsonian Institution's National Museum of Natural History (NMNH).

An additional three *carolinensis* individuals from Louisiana (LA; Braun and Robbins 1986) were also sequenced for cytochrome b. These specimens represented the western *carolinensis* mitochondrial haplotype (Sawaya 1990; Gill et al. 1999) and their sequences were used to help characterize the OH and TN *carolinensis* samples by eastern or western haplotype.

Section 2 Molecular Methods

P. carolinensis breast muscle tissue and *atricapillus* blood were subsampled and DNA was extracted using an AutoGenprep 965 extraction system (Autogen). DNA concentration and purity were determined using a NanoDrop ND-1000 spectrophotometer. Unused DNA was archived at NMNH.

Subsection 1 Cyt-b

The mtDNA cytochrome b gene was sequenced using primers L14990 and H15647 (Kocher et al. 1989), yielding a 657 bp fragment. The amplification PCR included 1 X GoTaq PCR buffer (Promega), 0.2 mM of each dNTP, 1.0 μ M of each

primer, 1.5 mM MgCl₂, 0.625 U Taq polymerase (Promega GoTaq), and 5 ng of whole genomic DNA in a 25 µL reaction vessel. The cycling profile consisted of 35 repetitions of 95° C for 30 s, 50° C for 30 s, and 72° C for 60 s, with a final 10 min hold at 72° C for fragment extension. PCR products were cleaned using 3.0 µL of Exosap-IT (United States Biochemical). The sequencing reactions included 80 mM Tris pH 9.0, 2 mM MgCl₂, 1 µM primer, 2 µL amplification product, and 0.75 µL BigDye (Applied Biosystems) in a 10 µL reaction. The cycle-sequencing profile consisted of 30 cycles of 94° C for 30 s, 50° C for 15 s, and 60° C for 4 min, followed by a 10° C hold. Sequencing products were cleaned with Sephadex G-50 columns (GE Healthcare). Sequencing was performed on an ABI 3730xl DNA Analyzer (Applied Biosystems). Chromatograms were examined and sequences trimmed, assembled, and edited using Sequencher 4.10.1 (Gene Codes Corp.). Consensus sequences for all individuals were aligned with Sequence Alignment Editor v2.0a11 (<http://iubio.bio.indiana.edu/soft/iubionew/molbio/dna/analysis/Pist/main.html>). Identical haplotypes were identified using MacClade 4.08 (Sinauer Associates Inc.).

Subsection 2 AFLP

AFLPs were generated following the protocol of Vos et al. (1995) as modified for vertebrates by Kingston and Rosel (2004). Two hundred ng of whole genomic DNA was first digested with restriction enzymes *EcoRI* and *TaqI* (New England Biolabs, Beverly, MA). Double-stranded adapters (Table 2) were ligated to the restriction fragments to provide a template for PCR primers. In the first of two PCRs, primers complementary to the adapters, but with an additional adenosine residue, were used to amplify a subset of restriction fragments. This preselective PCR

solution contained 1 X PCR buffer (Promega), 1.5 mM MgCl₂, 75 ng *EcoRI* + A primer, 75 ng *TaqI* + A primer, 0.2 mM dNTPs, 1 U Taq polymerase, and 5 µL restriction/ligation product in a 50 µL reaction. A second set of selective PCRs were carried out in 20 µL reactions containing 1 X PCR buffer, 1.5 mM MgCl₂, 5 ng labeled *EcoRI* + ANN primer, 30 ng *TaqI* + ANN primer, 0.2 mM dNTPs, 0.4 U Taq polymerase, and 5 µL diluted preselective PCR product. Ten selective PCR primer pairs were used, consisting of all combinations of two fluorescently labeled *EcoRI*+ANN primers and 5 *TaqI*+ANN primers. Fragment profiles were generated by capillary electrophoresis on an ABI PRISM 3130xl Genetic Analyzer (Applied Biosystems).

Table 2: AFLP adapter and primer sequences. These are the adapters and primers used in AFLP marker generation, representing adapter ligation, preselective amplification of fragments, and selective amplification and labeling of loci. Selective primer pair combinations used in this study are given in Table S3. Only *EcoRI* selective primers are fluorescently labeled, limiting the resulting chromatogram to the rarer *EcoRI-TaqI* or *EcoRI-EcoRI* restriction fragments.

Primer	Sequence
<i>TaqI</i> forward adapter	5' - /5phos/ GAC GAT GAG TCC TGA C - 3'
<i>TaqI</i> reverse adapter	5' - /5phos/ CGG TCA GGA CTC AT- 3'
<i>EcoRI</i> forward adapter	5' - /5phos/ CTC GTA GAC TGC GTA CC - 3'
<i>EcoRI</i> reverse adapter	5' - /5phos/ AAT TGG TAC GCA GTC TAC - 3'
<i>EcoRI</i> + A preselective	5' - GAC TGC GTA CCA AAT CA - 3'
<i>TaqI</i> + A preselective	5' - GAT GAG TCC TGA CCG AA - 3'
<i>EcoRI</i> + AAC (6-FAM labeled)	5' - /5 6FAM/ GAC TGC GTA CCA ATT CAA C 3'
<i>EcoRI</i> + AAG (HEX labeled)	5' - /5HEX/ GAC TGC GTA CCA AAT CAA G 3'
<i>TaqI</i> + AAC	5' - GAT GAG TCC TGA CCG AAA C 3'
<i>TaqI</i> +AAG	5' - GAT GAG TCC TGA CCG AAA G 3'
<i>TaqI</i> + ACA	5' - GAT GAG TCC TGA CCG AAC A 3'
<i>TaqI</i> + ACT	5' - GAT GAG TCC TGA CCG AAC T 3'
<i>TaqI</i> + AGA	5' - GAT GAG TCC TGA CCG AAG A 3'

Fragment data were generated with GeneMapper 4.0 software (Applied Biosystems). All samples were scored concurrently and blindly for each selective primer pair. AFLP fragments were scored in 1 bp bins and ranged in size from 90 bp to 350 bp. The scoring protocol developed by Kingston and Rosel (2004) was used to minimize potential noise associated with underamplification of large fragments or uneven amplification among samples. Fluorescence peaks less than 100 fluorescence units were not scored as marker loci. The presence of false-negative peaks (less than 100 fluorescence units) in a bin with scorable peaks from other individuals resulted in the rejection of the marker. For each primer pair, the fragment length of the largest monomorphic marker was taken as the upper size limit for scorable loci to prevent scoring problems resulting from PCR drop off with fragment length. One sample from each population was reprocessed for all primer pairs and scored anonymously and concurrently with all other samples to verify reproducibility of AFLP marker generation.

Section 3 Analyses

Subsection 1 mtDNA cytochrome b

To insure high accuracy of the data used for population genetic analysis, all comparisons were performed on a 535 bp region for which double stranded sequence was obtained for all sampled individuals. I constructed a cytochrome-*b* haplotype network using the median-joining method in the program Network 4.5 (fluxus-engineering.com, Bandelt et al. 1999). Molecular diversity indices, and the partitioning of variation in mtDNA sequences between species, among populations,

and within populations were assessed with the Analysis of Molecular Variance (AMOVA) routine in Arlequin 3.5 (Excoffier et al. 2005).

Subsection 2 AFLP

Using individual AFLP fingerprints, I constructed three-dimensional ‘clouds’ of all sampled populations using the ordination technique Non-metric Multidimensional Scaling (NMDS) in the software NTSYSpc (Rohlf 2000). Because *carolinensis* and *atricapillus* formed distinct clusters, this allowed us to identify any individuals with extensive admixture, which would appear spatially intermediate between parental species. A Jaccard similarity matrix was calculated from AFLP data for all pairs of individuals using the equation $J_{ij} = n_{11}/(n_{11} + n_{01} + n_{10})$, where n_{ij} is the number of polymorphic markers for which the character states (1 or 0) are found for a pair of samples i and j . This approach is appropriate for determining similarity between AFLP genotypes because it is conservative in that it does not assume that the band-absent phenotypes are homologous. The Jaccard matrix was used to generate a Principal Coordinates Analysis, which served as the input for NMDS. A stress value set from 0.0 to 1.0 was used to measure goodness of fit, where zero indicated perfect fit between the NMDS coordinates and the Jaccard matrix, and one indicates no relationship between the two. Each individual was plotted in ordination space using its three-dimensional coordinates.

As with Cyt b, I tested the partitioning of the AFLP variation using the AMOVA procedure in Arlequin 3.5 (Excoffier et al. 2005). I also used this analysis method to quantify population differentiation in AFLP loci among populations and calculate pairwise F_{ST} values. AFLP profiles were coded as binary haplotypic RFLP

data, and significance was calculated from 100172 permutations. These F_{ST} values provide useful measures of genetic differentiation between pairs of populations, but they are not calculated from allele frequencies and therefore cannot be directly compared to F_{ST} values determined using codominant markers (Excoffier et al. 2005).

We used the Bayesian population genetic clustering algorithm in the software STRUCTURE 2.3 (Pritchard et al. 2000) adjusted for dominant markers (Falush et al. 2007) to cluster individual AFLP genotypes and provide a more nuanced and statistically rigorous estimate of individual and population admixture than possible in NMDS. To determine the most appropriate model, I first tested several combinations of input parameters at all levels of k clusters: with or without admixture, sampling location priors, and alleles correlated between populations. I then used the most appropriate model to determine the Q-values of all individuals by running the model for each value of k (from $k = 1-14$) replicated ten times with burn-in of 100,000 steps followed by MCMC sampling of 1,000,000 steps. After completing STRUCTURE runs, the results of the unsupervised STRUCTURE replicates were aligned using CLUMPP 1.1.2 (Jakobsson and Rosenberg 2007), and generated graphics using DISTRUCT 1.1 (Rosenberg 2004). I chose to present all informative values of k generated by the unsupervised models instead of choosing a specific k value for two reasons: 1) there may be more than one biologically informative value of k , and 2) the established criteria for choosing an optimal k value rely on *ad hoc* methods (Pritchard et al. 2000, Evanno et al. 2005).

We augmented the STRUCTURE results with a simple test for introgression using frequentist statistics. Great Smoky Mountain *atricapillus* were divergent in

frequency from their parental populations at a number of AFLP loci. If this divergence was due to introgression from *carolinensis*, it should be possible to predict the direction of GSM divergence for each locus from the *carolinensis* gene frequency for that locus. If divergence was due to local differentiation of the GSM population, its directionality should be random with respect to *carolinensis* gene frequency. To determine whether these loci showed an overall pattern of introgression, a subset of markers were chosen where the frequency difference of positive AFLP phenotypes between parental *atricapillus* and the focal population was above 7.5% (corresponding to 2/28 Great Smoky Mountain birds or 3/40 parentals). The frequency of the band present phenotype in the GSM population also had to be free to vary in either direction around the frequency of the parental *atricapillus*, necessitating an upper boundary of 90% and a lower boundary of 10% in parentals. This left 17 loci that met the criteria. A sign test was used to determine whether the frequency difference in the Great Smoky Mountain population with respect to parentals was biased towards *carolinensis* (indicative of introgression), or varied around the frequency of the parental population in a random fashion.

To determine if AFLP loci were associated with genomic regions under diversifying selection between *atricapillus* and *carolinensis*, I used a Bayesian simulation-based test after Beaumont and Balding (2004). The population genetic software Bayescan (Foll and Gaggiotti 2008) uses a Reversible Jump Markov Chain Monte Carlo (RJMCMC) to detect loci under selection. This method uses population-specific F_{ST} , incorporating both population- and locus-specific effects. The posterior probability of a locus being under selection is determined by assuming

models with and without selection. Bayescan has advantages over the commonly used FDIST2 because it models F_{ST} using a logistic regression model incorporating both a locus and population effect instead of an island model, and by directly estimating posterior probabilities of locus-specific selection by calculating a Bayes factor, or the ratio of the posterior probabilities of the selection and neutral models, given the data (Perez-Figueroa et al. 2010). Loci were considered outliers if the ratio of the selection hypothesis to the neutrality hypothesis was $\log_{10}(\text{Bayes factor}) > 1.5$, or > 2 , corresponding to a posterior probability of 0.97 and 0.99, respectively. These values are considered very strong and decisive evidence of selection, respectively, and represent a strict enough criterion to avoid false-positive detection of loci under selection (Foll and Gaggiotti 2008). The analysis consisted of 10 pilot runs with 5000 iterations, followed by 100,000 iterations. Replicate analyses indicated this was enough to achieve convergence. This method was used to test two data sets: one containing all 276 loci and one with only those loci that could be assigned to chromosome types (see below).

We reasoned that, because birds have ZW sex-determination, it should be possible to identify Z linked AFLP loci due to unequal fragment fluorescence between homogametic males and heterogametic females. Females have two copies of autosomal genes, but only one copy of sex-linked ones. For most AFLP loci, the distribution of fluorescence intensity of males and females overlapped broadly. For a few loci, these distributions were clearly distinct, with male mean fluorescence roughly twice that of females, suggesting that those loci derive from the Z chromosome. Loci for which band-present females were common but band-present

males were absent were identified as W-linked (Griffiths and Orr 1999). I tested whether individual loci were Z-linked in a qualitative fashion, using graphs of individual fluorescence, and in a quantitative fashion using a t-test. Only a subset of the entire AFLP data matrix was testable with the t-test because most loci were present at insufficient frequency to ensure high statistical power. The only criterion for inclusion was that the locus be band positive in at least ten females (out of 32 total females). A two-tailed, heteroscedastic t-test with a correction for multiple comparisons (p-value of 0.000297619 or less was considered significant) was used to test for Z-linkage.

Chapter 3: Results

Section 1 mtDNA

Comparison of consensus sequences of a 535bp mtDNA cytochrome-*b* fragment between *atricapillus* and eastern *carolinensis* yielded 15 substitutions, or a level of divergence of 2.8%. There were no shared haplotypes between species (Table 3, Figure 2, Figure 3), and most individuals within each species had identical haplotypes, except for a small number of one- and two-base pair substitutions (Figure 2). No individuals were identified as migrants (Figure 3), all *carolinensis* exhibited the eastern haplotype (Gill et al. 1999), and there was no evidence of *carolinensis* mtDNA introgression into the GSM *atricapillus* population. Cytochrome b molecular diversity was lower for GSM than for all other populations. 97.57% of variation was between species, the rest within, as determined by AMOVA.

Table 3. mtDNA haplotypes. Count of mitochondrial haplotypes of each population of chickadees.

Population	N	mtDNA haplotype		
		<i>atricapillus</i>	<i>carolinensis</i> (Eastern)	<i>carolinensis</i> (Western)
Pennsylvania	20	20	0	0
West Virginia	20	20	0	0
Great Smoky Mts	30	30	0	0
North Carolina	30	0	30	0
Tennessee	30	0	30	0
Virginia	21	0	21	0
Ohio	20	0	20	0
Louisiana	3	0	0	3

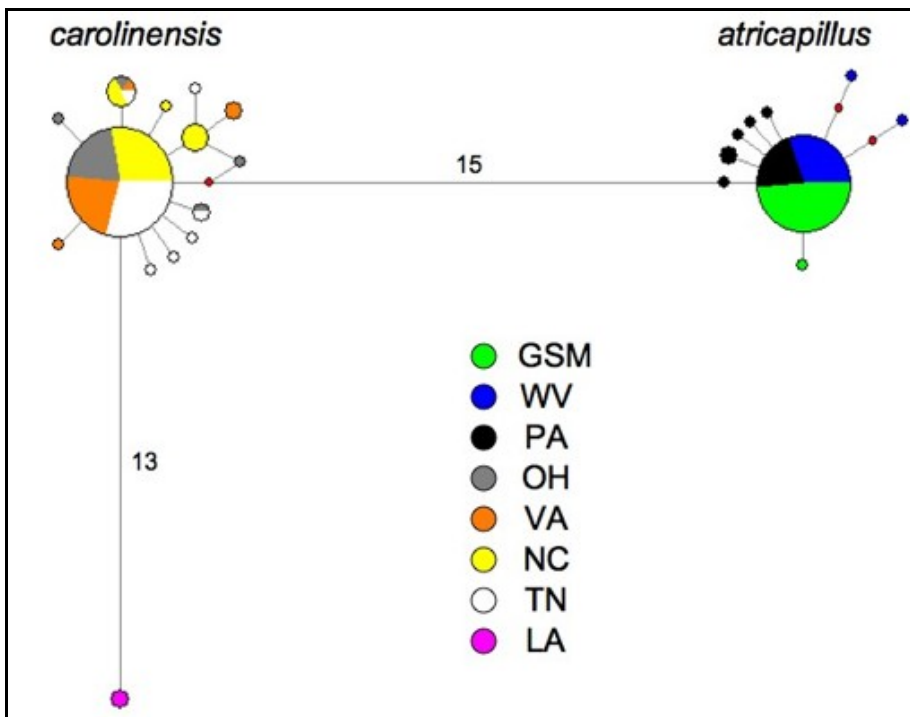


Figure 2. Chickadee mtDNA cytochrome-*b* median-joining network. Median joining network created using 535bp of the mtDNA cytochrome-*b* gene from 70 *Poecile atricapillus* and 103 *P. carolinensis*. Circles (nodes) represent distinct haplotypes and are proportional in area to the number of sampled individuals. One inferred node (in red) connects *atricapillus* and *carolinensis*. All individual branch lengths are one substitution unless otherwise labeled by underlined numbers.

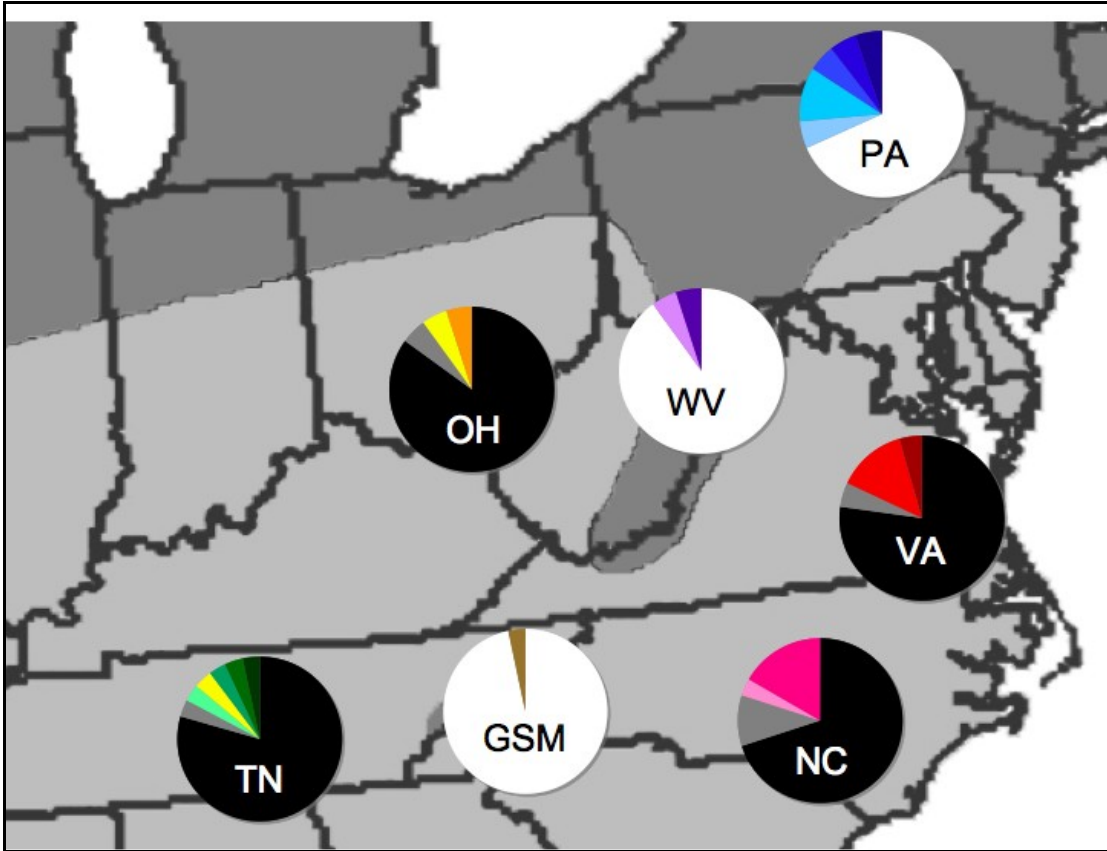


Figure 3. Geography of cytochrome-*b* haplotypes. Each population is represented by a circle. Individual colored portions denote haplotype proportions in populations, and are true to scale. The colors do not correspond to colors in figure 2, but rather to the individual haplotypes.

Section 2 AFLP

I generated 276 AFLP loci from 10 primer pairs. Of these, 11 were monomorphic and 265 were polymorphic. Three had fixed differences between parental *atricapillus* and *carolinensis* populations and two more had frequency differences > 0.9 . When diagnostic AFLP locus scores were compared with cytochrome *b* haplotypes, no individuals exhibited cytonuclear mismatch and no migrants were detected.

NMDS of multi-locus AFLP scores revealed two clouds of individuals, corresponding to the two forms. Population centroids of *carolinensis* were tightly

clustered, while those of *atricapillus*, especially GSM, were more dispersed (Figure 4). There was no evidence of F1 hybrids, or of substantial qualitative intermediacy in the GSM population according to the NMDS analysis.

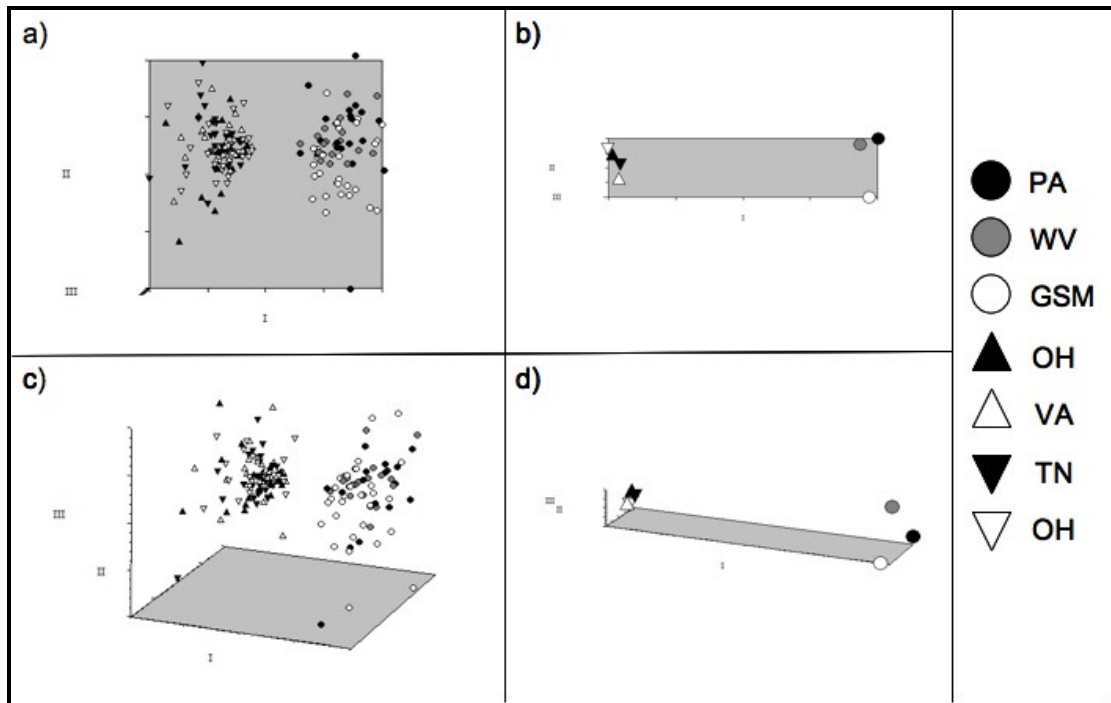


Figure 4. NMDS ordination of multilocus AFLP genomes. NMDS clouds representing the least-stress ordination of pairwise Jaccard similarity matrices developed from individual multilocus AFLP scores. Population codes: PA - Pennsylvania, WV - West Virginia, GSM - Great Smoky Mountains, OH - Ohio, VA - Virginia, TN - Tennessee, OH - Ohio. Panels **a** and **c** show the NMDS clouds of individuals from different perspectives. The axes are non-metric, and thus only convey relative, but not absolute, distance. Panels **b** and **d** show the population centroids corresponding to **a** and **c**, respectively.

Results of AMOVA for AFLP with species and population hierarchical genetic structure indicated that genetic variation was partitioned into 22.27% by species, 1.63% among populations within species, and 76.10% within populations.

Pairwise F_{ST} showed that GSM *atricapillus* were less distant from *carolinensis* populations than were the parental *atricapillus* populations, and that GSM was significantly different from parental conspecifics (Table 4).

Table 4. Pairwise F_{ST} for chickadee populations based on 276 AFLP loci. This table shows pairwise F_{ST} values as calculated from the full AFLP data set by the AMOVA procedure in Arlequin. These F_{ST} values are not directly comparable to those generated for codominant data, but serve to indicate the differentiation between populations of *atricapillus* and *carolinensis*. Population codes- *atricapillus*: PA- Pennsylvania, WV- West Virginia, GS- Great Smoky Mountains; *carolinensis*: OH- Ohio, VA- Virginia, NC- North Carolina, TN- Tennessee.

	WV	PA	GSM	VA	OH	NC
WV						
PA	0.00687					
GSM	0.02546	0.04169*				
VA	0.24507*	0.25780*	0.22510*			
OH	0.23811*	0.24000*	0.19781*	0.01934		
NC	0.24214*	0.25106*	0.20802*	0.00028	0.00753	
TN	0.26558*	0.26641*	0.23059*	0.03026*	0.02512	0.01891

* denotes significance at Bonferroni corrected $p < 0.00238$

Posterior probabilities were highest for STRUCTURE models including admixture, population priors, and correlated alleles. Models were run for values of k from 2 - 7, but partitioning of the genome into clusters was only informative for k from 2-4. The results of the $k=2$ model suggested introgression of *carolinensis* alleles into the GSM *atricapillus*, comprising ~5% of their genome (Figure 5). A low level of introgression of *atricapillus* alleles into OH is also evident, consistent with results reported by Sattler and Braun (2000). Interestingly, in the $k=4$ model there was evidence of local differentiation (5-10% of the genomic signal) in the GSM *atricapillus* population, some of which was shared at a lower frequency by NC *carolinensis* (see Figure 6).

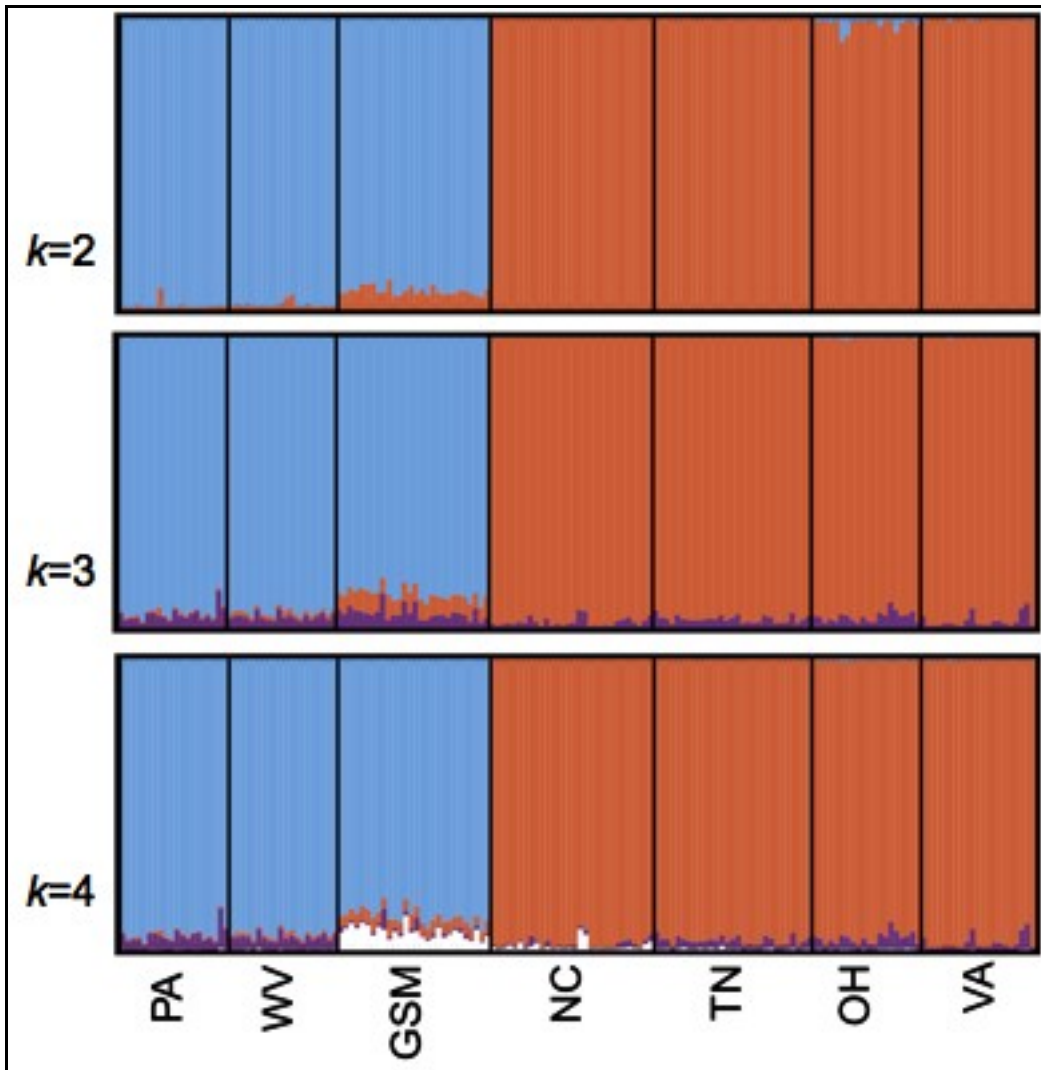


Figure 5. STRUCTURE analyses for AFLP dataset. Unsupervised STRUCTURE runs for three values of k (inferred population clusters) from 2-4. Each vertical line represents one individual and geographic samples are delineated by black lines. Colors denote source population clusters inferred by the analyses. At $k = 2$, the clusters correspond to *atricapillus* (blue) and *carolinensis* (orange). The purple cluster at $k = 3$ represents low-level individual variation. The signal of low-level individual variation is partitioned into two clusters in $k = 4$: one specific to GSM and NC (white), and one for all other populations (purple). Population codes: (*atricapillus*) PA - Pennsylvania, WV - West Virginia, GSM - Great Smoky Mountains (*carolinensis*) NC - North Carolina, TN - Tennessee, OH - Ohio, and VA - Virginia.

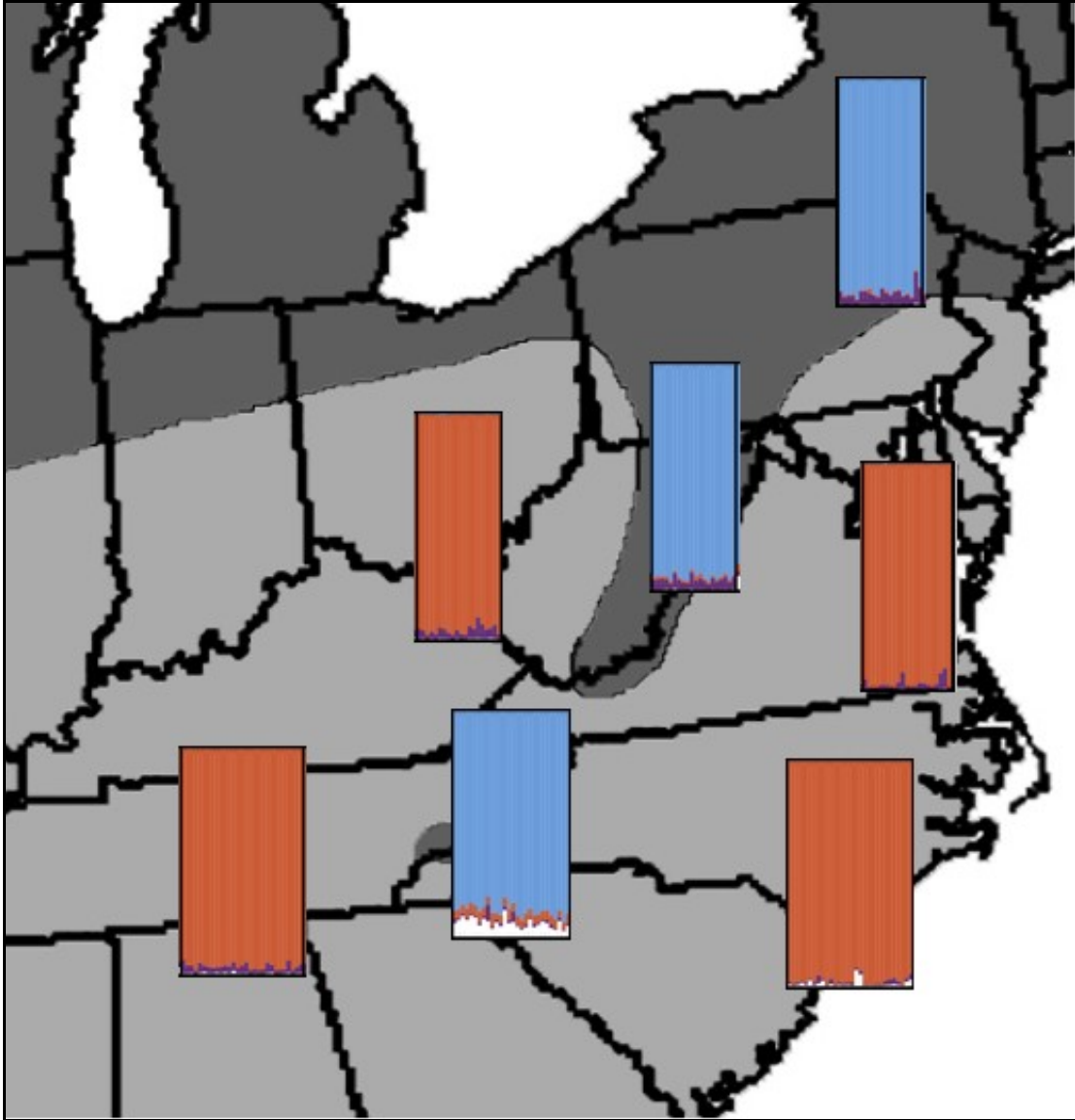


Figure 6. Geographic pattern of introgression and differentiation. Each box portrays the STRUCTURE results at $k = 4$ for a population of chickadees, and is placed according to geographic sampling location. Each individual is represented by a thin column, which is partitioned into K colored segments, corresponding to membership fractions in K clusters. Colors: blue- *P. atricapillus*, orange- *P. carolinensis*, purple- individual variation, white- local variation associated with GSM and NC.

Of the 17 loci used in the sign test for introgression, the GSM population frequency was biased towards *carolinensis* for 14 loci. This is significantly different from the null hypothesis that the focal population allele frequencies would vary freely around the parental *atricapillus* frequencies ($p = 0.013$).

There was a striking difference in average fluorescence between males and females at a small fraction of AFLP loci, which were suspected to be due to sex linkage (Figures 7a, 7b). There were 78 loci with sufficient sample size to test for sex linkage, of which 10 (12.8%) were Z-linked (Figure 7c). Two loci of the total data set of 78 were present in at least one third of females ($n = 10$) and no males, and were considered W-linked (0.72%). These values agree roughly with the expected values based on the size of the Z and W chromosomes relative to autosomes (Smith and Burt 1998).

Figure 7. Z-linked and autosomal AFLP Loci. These figures show the striking difference in average fluorescence between males and females at z-linked AFLP loci, but not at autosomal loci. In all cases, females are shown in red and males are shown in blue. Each graph represents one locus and many individuals ranked by fluorescence. Each bar is an individual's fluorescence for the selected locus. In autosomal loci (a), where both males and females CAN BE homozygous or heterozygous, the mean and range of fluorescence amplitudes is similar in males and females. In Z-linked loci (b), where females are ALWAYS hemizygous, females exhibit a mean roughly half that of males. Figure 6c shows the t-test values for 78 testable loci. The Bonferroni-corrected alpha value for significance was a $p < 0.0003$.

Figure 6a. Autosomal AFLP locus

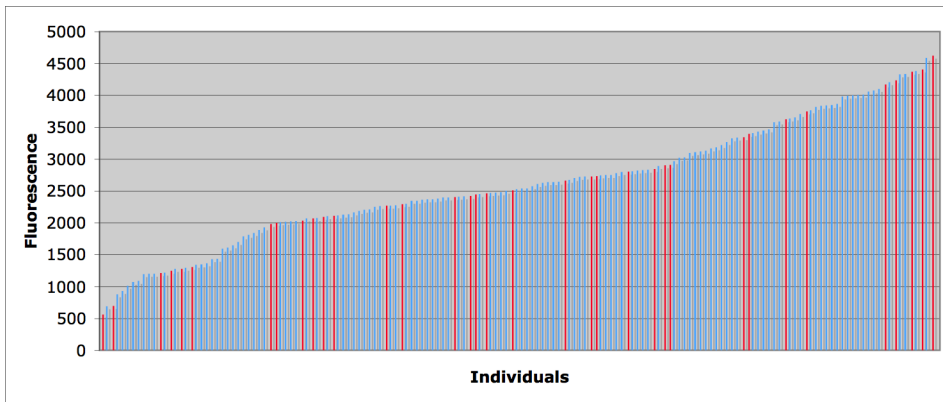


Figure 6b. Z-linked AFLP Locus

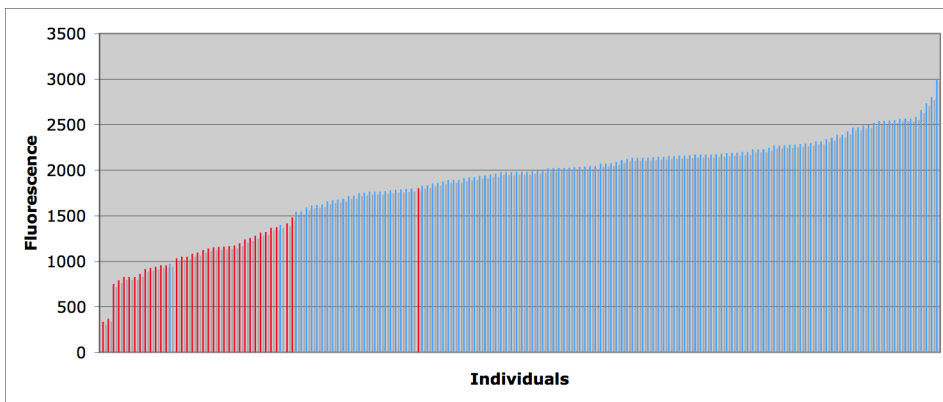
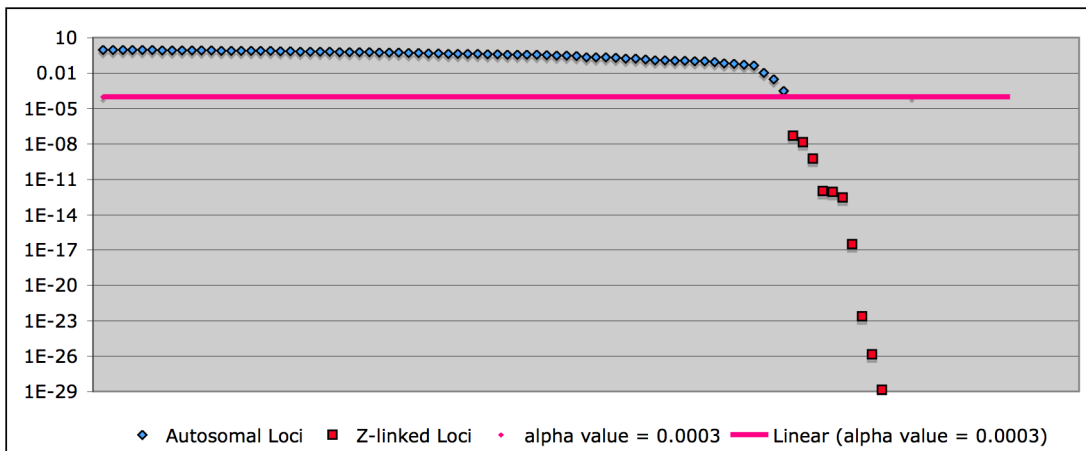


Figure 6c. T-test p-values of Autosomal and Z-linked Loci



When these 78 AFLP loci were entered into the RJMCMC analysis in Bayescan, 9 (11.54%) showed ‘very strong’ evidence of selection, of which 8 (10.25%) showed ‘decisive’ selection (Figure 8). Of the loci under selection, four were Z-linked, one was W-linked, and three were autosomal. Thus, 5 of 12 (42%) sex-linked loci showed decisive evidence of selection, while only 10 of 66 (15%) autosomal loci did (Figure 8).

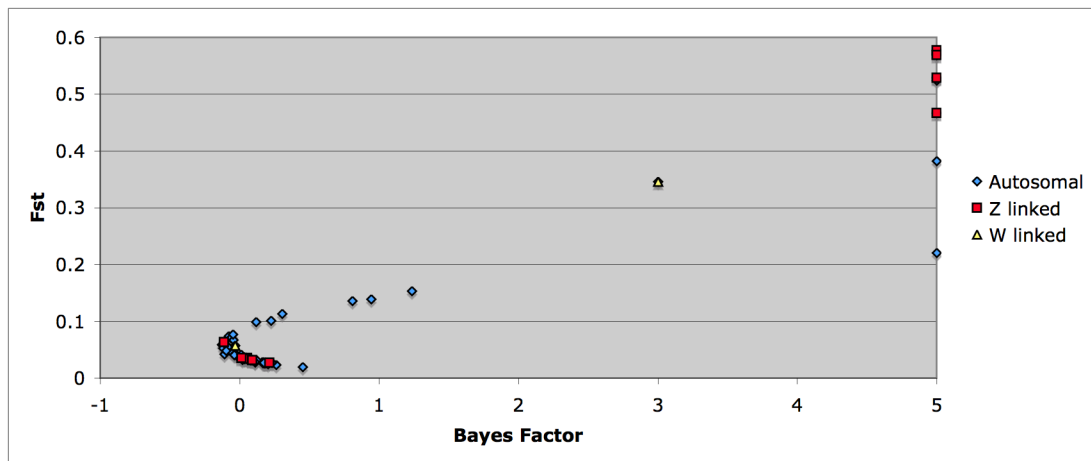


Figure 8. Detection of selection among AFLP loci. These graphs show the Bayescan results for detection of loci under selection. Bayes Factors (BF) of 1.5 and 2 correspond to α values of 0.025 and 0.01, respectively. Only those loci that were assignable to different chromosomes were plotted. In either graph, most AFLP loci had non-significant F_{ST} values. Of the loci with significant F_{ST} values, sex-linked loci were overrepresented relative to autosomal loci, suggesting that sex-linked genes play a role in continued reproductive isolation between *atricapillus* and *carolinensis*.

Chapter 4: Discussion

The focal GSM population was different from parental *atricapillus* in multilocus AFLP fingerprint, but not for mitochondrial haplotype. AMOVA performed on the AFLP data set revealed a small but significant difference between the focal population and the northern parentals, indicative of divergence. The same analysis revealed that GSM was also less distinct from *carolinensis*, which suggested introgression. The results of the sign test revealed that most AFLP loci where GSM differed from parental conspecifics were biased in frequency towards *carolinensis*, providing clear evidence of introgression. These results were supported by those from STRUCTURE, which indicated a small but significant and uniform signal of introgression in all members of the GSM population.

Although significantly introgressed, the GSM population of *atricapillus* does not appear to be genetically swamped by introgression from the surrounding populations of *carolinensis*, even though it is closer to the range interface than populations exhibiting much higher levels of introgression in other studies (Rhymer and Simberloff 1996, Sattler and Braun 2000, Bronson et al. 2005, Reudink et al. 2007). No cases of mtDNA introgression were observed. Although mtDNA clines were narrow in other studies (e.g. Sattler and Braun 2000), they were wide enough to suggest that the geographical extent of the focal *atricapillus* population was insufficient to remove all mtDNA introgression by selection alone. The small but uniform signal of AFLP introgression from *carolinensis* in this population suggests low levels of hybridization and a stable dynamic of admixture. All these results point to a very low level of gene flow from *carolinensis*; lower than in other areas where

hybridization has been well studied in these species (Sattler and Braun 2000, Bronson et al. 2005, Reudink et al. 2007).

Unlike other areas of contact between *atricapillus* and *carolinensis*, in the Great Smoky Mountains hybridization seems to be reduced by the presence of a behaviorally-mediated incipient speciation mechanism; i.e. the elevational gap between the species. The most likely explanation for this unique result is that the elevational gap between the species in the Great Smoky Mountains actually does act to retard hybridization and introgression.

These results suggest a unique reproductive barrier is at work at this isolated contact zone between *atricapillus* and *carolinensis*. Tanner (1952) suggested that the continued existence of Great Smoky Mountain *atricapillus* was due to the breeding season gap in elevation as well as to the relatively large and dense population. *P. atricapillus* in the Great Smoky Mountains may be more likely to engage in assortative mating than *atricapillus* populations near the main range contact zone due to these factors. Also, the large individual size of GSM *atricapillus* males relative to other Appalachian populations (Tanner 1952) may retard hybridization by conferring a sexual selective advantage over *carolinensis* males (Bronson 2003b).

A signal representing local differentiation of the Great Smoky Mountain population of *atricapillus* emerged in the STRUCTURE analysis. Differentiation in the Great Smoky Mountain population of *atricapillus* could either be a signal of post-glacial colonization of these montane sky islands followed by local adaptation and divergence, or of older pre-glacial diversity preserved in a relictual population during one or more glacial maxima. I was not able to differentiate between these hypotheses

using my data set. However, the signal of local differentiation in GSM *atricapillus* was shared with NC *carolinensis*, suggesting that cryptic genetic introgression may be bidirectional in the southern Appalachian region.

Within historic time, there were several island-like populations of *atricapillus* scattered among high elevation habitats in the southern Appalachians. This metapopulation existed outside of the species main range farther to the north. Several lines of evidence suggest the presence of one or more glacial refugia in the southern Appalachians during previous glacial maxima (Church et al. 2003, Zamudio and Savage 2003, Austin et al. 2004, McLachlan et al. 2005). Many other north temperate taxa have high levels of endemism in the southern Appalachians, which suggests long residence time (Braun 1951). It is possible that *atricapillus* also followed this history. *P. atricapillus* and *P. carolinensis* have a relatively high level of mtDNA divergence (3.8% in Gill et al. 1993, 2.8% this study), which suggests that the current hybrid zone(s) between these species may be the latest in a series of iterations dating back much earlier than the last glacial maximum circa 18 kya.

The evident divergence of GSM from parental *atricapillus* populations agrees with a review that proposed a subspecific epithet for the Appalachian Black-capped chickadee (*P. a. practicus*), based on a type specimen taken in the Great Smoky Mountains in 1932 (Oberholser 1932). Originally, *practicus* was meant to include all populations of *P. atricapillus* in the Appalachian Mountains, but I did not find the same signal of differentiation in the parental population from West Virginia. Interestingly, Oberholser's description of *P. a. practicus* in the Appalachians

characterized the subspecies as more like *carolinensis* than was the nominal *atricapillus* (Simpson 1977).

The types of markers used in this study showed quite different signals of introgression, and gave different perceptions of the extent of hybridization. Sex-linked markers, including both mtDNA and Z- and W-linked AFLPs, were more likely to exhibit strong differentiation, probably due to diversifying selection between species. This study, among the first to distinguish varying levels of differentiation at autosomal and sex-linked AFLP loci, supports the hypothesis that sex chromosomes can play an important role in incipient speciation and continued reproductive isolation (Sattler and Braun 2000, Carling and Brumfield 2008, Qvarnström and Bailey 2009). That a large proportion of the sex-linked loci are under diversifying selection in this system is consistent with Haldane's rule in birds (Tegelström and Gelter 1990). Four of ten Z-linked loci and one of two W-linked loci showed 'decisive' selection according to Bayescan, compared with just 10 of 66 autosomal loci.

Mitochondrial DNA introgression was not detected in any of the GSM sample, making this among the most structured markers between *carolinensis* and *atricapillus* in this study. Often diagnostic markers have been used in hybridization research because intermediacy in a diagnostic marker is an unambiguous signal of hybridization. However, markers chosen for high levels of differentiation are more likely to be under purifying selection, which limits the ability to detect and measure introgression (Yuri et al. 2009). In this study the AFLP fingerprints exhibited lower and more variable structuring between species than did the mtDNA haplotypes. This

may be due to lower average levels of purifying selection on AFLP loci, allowing greater sensitivity for the detection of introgression.

Several inherent biases in the sampling strategy should be recognized. First, the sample of individuals in the Great Smoky Mountains was heavily biased towards males due to the use of song playback for netting birds (n=3 for females, n=25 for males). In many other songbirds, including *atricapillus*, females disperse farther than males (Weise and Meyer 1979, Greenwood 1980). Thus the sex most likely to immigrate was underrepresented in the GSM sample.

It is also of interest that chickadees form pair bonds in winter flocks (Smith 1991). In the Great Smoky Mountains, *atricapillus* move downslope in the non-breeding season and likely flock with *carolinensis* (Tanner 1952, Simpson 1992). Great Smoky Mountain *atricapillus* are also larger than local *carolinensis* (Tanner 1952), which may make them attractive as mates. In a study of where females were allowed to choose between males of each species, Bronson et al. (2003b) reported that females prefer larger, more socially dominant males, regardless of species. Thus, it is possible that female *carolinensis* sometimes choose the larger *atricapillus* as mates, and move upslope with their mates just prior to the breeding season. The paucity of females in my GSM sample makes it unlikely that migrant *carolinensis* females would be detected. However, these biases are unlikely to alter my main conclusions.

Appendices

Supplementary Figures and Tables

Figure S1a.

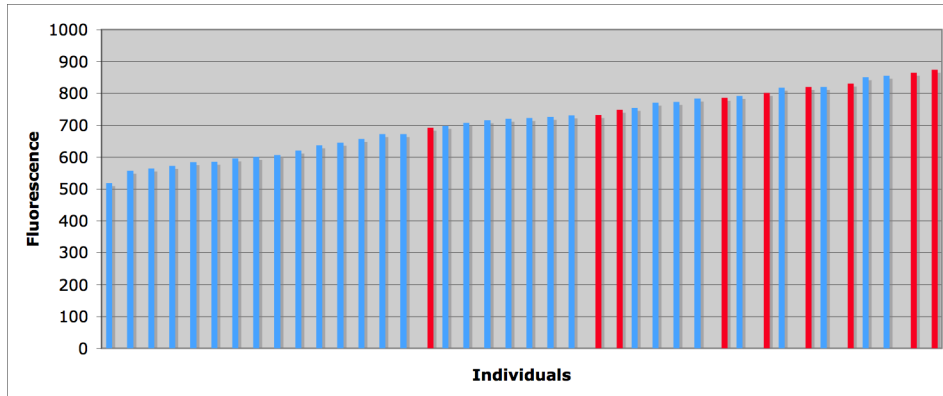


Figure S1b.

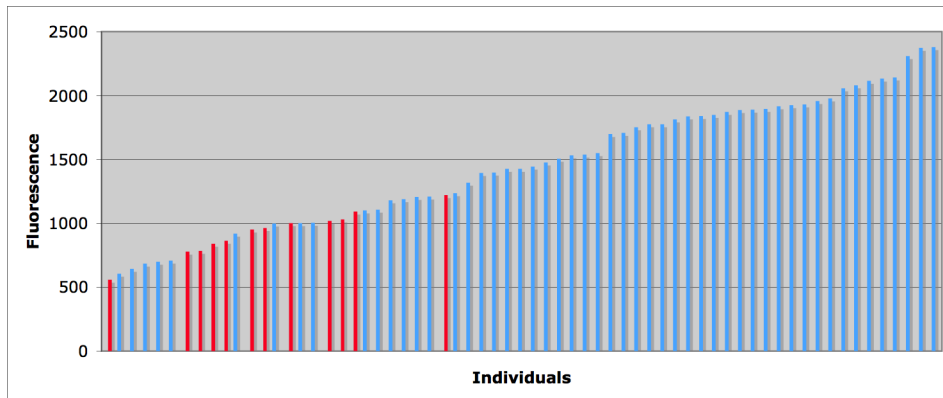


Figure S1. Autosomal and Z-linked AFLP loci exhibiting high differentiation between species.

These graphs each depict loci that are highly differentiated between species. Each bar represents the fluorescence for one individual. Blue- males, red- females. For Z-linked loci, females have roughly half the mean fluorescence of males.

Table S1. List of AFLP loci and chromosome type. This is the entire AFLP data set. Loci are labeled according to the following convention (fragment length _ primer pair). Primer pair combinations are given in Table S3. Chromosome types are as follows: a- autosomal, z- Z-linked, w- W-linked, blank- insufficient sample size for chromosome determination.

Locus #	type	Locus #	type	Locus #	type	Locus #	type	Locus #	type	Locus #	type
97_01	a	311_02		236_04		132_09		253_10	a	226_12	a
112_01		316_02		237_04		140_09		255_10		233_12	
140_01		318_02		249_04		152_09	a	289_10		244_12	
142_01	z	326_02	a	272_04	a	164_09	a	294_10		265_12	
151_01		329_02		276_04		168_09		297_10		267_12	
152_01		331_02	a	291_04		176_09	a	300_10		282_12	a
169_01		332_02		295_04	a	178_09	a	301_10	a	288_12	
173_01		339_02	a	321_04		188_09	a	91_11		302_12	
176_01	a	341_02		324_04	z	194_09	a	102_11		304_12	a
181_01		343_02		327_04		202_09		105_11		98_13	
185_01		346_02		333_04		206_09	a	129_11		100_13	
186_01		351_02	a	342_04		207_09		133_11		101_13	
195_01		352_02		347_04		211_09		140_11		116_13	
204_01	a	98_03		355_04		213_09		154_11	a	118_13	a
236_01		124_03		359_04	a	216_09		158_11		131_13	a
240_01	a	126_03	z	483_04	a	242_09		186_11	a	138_13	
246_01		140_03		89_05	a	246_09		192_11		143_13	
262_01	a	165_03		97_05	a	257_09		205_11		146_13	a
275_01		203_03	a	101_05	a	263_09	a	208_11		149_13	
296_01		206_03		113_05		90_10		225_11		154_13	
313_01		210_03		117_05		92_10		236_11		156_13	a
350_01		226_03		121_05	z	96_10		239_11		169_13	
377_01		236_03	z	137_05	a	101_10		245_11		176_13	
393_01	a	269_03		139_05		113_10		258_11		198_13	
91_02		271_03		142_05		116_10		272_11		205_13	a
99_02		280_03		144_05		119_10		279_11		211_13	
100_02	a	294_03	w	162_05	a	121_10		282_11		212_13	
106_02		305_03		176_05		127_10		292_11		220_13	
108_02	z	312_03		180_05	a	132_10	a	295_11		235_13	a
134_02		321_03	a	238_05		151_10		298_11		240_13	a
138_02		325_03	a	240_05		160_10		309_11	w	255_13	
140_02		327_03	a	250_05		162_10		316_11		256_13	
142_02	a	330_03		255_05	z	166_10		319_11		258_13	a
157_02	a	362_03	a	258_05		172_10		328_11	z	263_13	
160_02		365_03		262_05		207_10	a	101_12		264_13	
164_02		394_03		269_05		212_10		105_12		308_13	a
182_02	a	413_03		279_05		216_10	a	120_12		317_13	a
202_02	a	420_03		298_05		221_10	a	122_12			
214_02		442_03		307_05		223_10		135_12			
235_02		110_04		309_05		225_10	a	144_12			
246_02		113_04		338_05		230_10		154_12			
248_02		120_04		349_05	a	233_10		172_12			
252_02		128_04	a	96_09		235_10		182_12			
256_02		141_04		102_09	a	239_10	a	184_12	a		

260_02	173_04	108_09		240_10	191_12	
264_02	184_04	112_09		244_10	207_12	
270_02	190_04	129_09	a	248_10	219_12	z
311_02	213_04	131_09	a	250_10	222_12	

Table S2. Complete AFLP Data Set. This table contains AFLP scores for all individuals and all loci. Populations are as follows: West Virginia (B127, B1636-B1654), Virginia (B2166-B2186), Ohio (B2187-B2206), Pennsylvania (B2207-B2226), Great Smoky Mountains (B28978-B29007), North Carolina (B29010-B29039), and Tennessee (B29040-B29069). B28984, B28985, and B29067 were excluded due to excessive missing data. Loci are labeled by the following convention 'fragment length'_'primer pair'. Primer pair combinations are given in Table S3, and primer sequences in Table 2.

	97_01	112_01	140_01	142_01	151_01	152_01	169_01	173_01	176_01	181_01	185_01	186_01	195_01	204_01	236_01	240_01	246_01	262_01	275_01	296_01	313_01	350_01	377_01	393_01	91_02	99_02	100_02	106_02	108_02	
B127	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B1636	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B1637	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	1	0	1
B1638	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B1639	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B1640	1	0	0	1	0	0	1	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B1641	1	0	0	1	0	0	0	0	1	0	0	0	1	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
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B1645	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
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B1649	1	0	0	1	0	1	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	1	0	1	0	0	1	0	0	
B1650	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	0	0	1	0	1	
B1651	1	0	0	1	0	0	0	0	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
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B2166	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1	
B2167	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0	1	0	1	
B2168	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2169	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2170	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0	1	0	1	
B2171	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1	
B2172	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2173	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	
B2174	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2175	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
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B2179	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	1	0	1	0	1	
B2180	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1	
B2181	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
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B2197	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2198	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B2199	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	1	0	1	0	1	
B2200	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1	
B2201	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B2202	1	1	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	1	0	1	1	1	

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B127	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
B1636	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
B1637	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
B1638	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
B1639	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B1640	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0
B1641	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B1642	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
B1643	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B1644	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0
B1645	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B1646	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B1647	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
B1648	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B1649	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B1650	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B1651	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
B1652	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B1653	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B1654	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0
B2166	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0
B2167	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
B2168	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0
B2169	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B2170	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2171	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B2172	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
B2173	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0
B2174	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2175	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0
B2176	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1
B2177	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0
B2178	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
B2179	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2180	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2181	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2182	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2183	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
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B2186	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B2187	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B2188	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
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B2191	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2192	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B2193	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2194	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B2195	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2196	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2197	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2198	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B2199	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
B2200	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0
B2201	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
B2202	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1

	351_02	352_02	98_03	124_03	126_03	140_03	165_03	203_03	206_03	210_03	226_03	236_03	269_03	271_03	280_03	294_03	305_03	312_03	321_03	325_03	327_03	330_03	362_03	365_03	394_03	413_03	420_03	442_03	110_04		
B127	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B1636	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	
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B1648	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	
B1649	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B1650	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B1651	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	
B1652	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	
B1653	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B1654	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B2166	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2167	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2168	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2169	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	
B2170	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	1	0	0	0	
B2171	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	
B2172	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	
B2173	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2174	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	
B2175	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	
B2176	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2177	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2178	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2179	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2180	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2181	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
B2182	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	
B2183	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2184	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	
B2185	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2186	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	
B2187	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2188	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	
B2189	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
B2190	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2191	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	
B2192	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2193	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	1	0	0	
B2194	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	
B2195	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2196	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2197	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2198	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2199	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	
B2200	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
B2201	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
B2202	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	

	198_13	205_13	211_13	212_13	220_13	235_13	240_13	255_13	256_13	258_13	263_13	264_13	308_13	317_13
B127	0	0	1	0	0	0	0	1	1	0	0	0	1	1
B1636	0	0	1	0	0	0	1	1	0	0	1	0	0	1
B1637	0	0	0	0	0	0	1	1	0	0	1	0	0	1
B1638	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1639	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1640	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1641	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1642	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1643	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1644	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1645	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1646	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1647	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1648	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1649	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1650	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1651	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1652	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1653	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B1654	0	1	0	0	0	1	1	0	1	0	0	0	0	1
B2166	0	1	0	0	0	1	1	1	0	1	0	0	0	1
B2167	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2168	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2169	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2170	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2171	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2172	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2173	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2174	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2175	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2176	0	1	0	0	0	0	1	0	0	1	0	0	0	1
B2177	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2178	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2179	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2180	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2181	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2182	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2183	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2184	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2185	0	1	0	0	0	1	0	0	0	1	0	0	0	1
B2186	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2187	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2188	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2189	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2190	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2191	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2192	1	1	0	0	0	1	1	0	0	1	0	0	0	1
B2193	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2194	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2195	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2196	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2197	1	1	0	0	0	1	1	0	0	1	0	0	0	1
B2198	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2199	0	1	0	0	0	1	1	0	0	1	0	0	0	1
B2200	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B2201	1	0	0	0	0	1	0	0	0	1	0	0	0	0
B2202	0	1	0	0	0	1	1	0	0	1	0	0	0	1

	97_01	112_01	140_01	142_01	151_01	152_01	169_01	173_01	176_01	181_01	185_01	186_01	195_01	204_01	236_01	240_01	246_01	262_01	275_01	296_01	313_01	350_01	377_01	393_01	99_02	100_02	106_02	108_02		
B2203	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2204	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0	1	0	1	
B2205	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2206	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1	
B2207	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1	0	0	1	0	1	
B2208	1	0	0	1	0	0	0	0	1	0	0	0	1	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B2209	1	0	0	1	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2210	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	1	0	0	1	0	0	1	0	1	
B2211	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B2212	1	0	0	1	0	0	1	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B2213	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	1	1	
B2214	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	
B2215	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B2216	1	1	0	1	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2217	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B2218	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	
B2219	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2220	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B2221	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	
B2222	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	1	0	1	0	0	1	0	1	
B2223	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	
B2224	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1
B2225	1	1	0	1	0	0	0	0	1	0	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1
B2226	1	1	1	1	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1
B28978	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B28979	1	0	0	1	0	0	0	0	1	0	0	0	1	1	0	1	0	1	0	1	0	0	0	1	0	0	1	0	1	
B28980	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1	0	0	1	0	1	
B28981	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B28982	1	0	0	1	0	0	0	0	1	0	0	0	1	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B28983	1	0	0	1	0	0	0	0	1	0	1	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B28986	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B28987	1	0	0	1	0	0	0	0	1	0	1	0	1	1	0	1	0	1	1	0	0	0	0	1	0	0	1	0	1	
B28988	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B28989	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B28990	1	0	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B28991	1	1	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
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B28993	1	0	0	1	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
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B28998	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
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B29002	1	1	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B29003	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B29004	1	1	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B29005	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0	1	0	1
B29006	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B29007	1	0	0	1	0	0	0	0	1	0	0	0	1	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B29010	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1	0	0	1	0	1	
B29011	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B29012	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	
B29013	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1	
B29014	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	

	351_02	352_02	98_03	124_03	126_03	140_03	165_03	203_03	206_03	210_03	226_03	236_03	269_03	271_03	280_03	294_03	305_03	312_03	321_03	325_03	327_03	330_03	362_03	365_03	394_03	413_03	420_03	442_03	110_04	
B2203	1	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	.	
B2204	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	
B2205	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	
B2206	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B2207	1	0	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B2208	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	
B2209	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	0	
B2210	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	
B2211	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	
B2212	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B2213	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B2214	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	.	
B2215	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	
B2216	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	
B2217	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	1	0	1	0	0	0	1	
B2218	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	
B2219	1	0	0	0	1	0	1	1	0	0	0	1	0	0	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0	
B2220	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	
B2221	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B2222	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	
B2223	1	0	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	
B2224	1	0	0	0	1	0	1	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	1	1	0	0	0	0	0	
B2225	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	.	
B2226	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	
B28978	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	
B28979	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	
B28980	1	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	0	
B28981	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	
B28982	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	
B28983	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B28986	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	
B28987	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B28988	1	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	
B28989	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B28990	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B28991	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	.	
B28992	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	
B28993	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	
B28994	0	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
B28995	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B28996	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B28997	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	
B28998	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B28999	1	0	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	
B29000	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	
B29001	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	
B29002	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	.	
B29003	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	
B29004	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	
B29005	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0	
B29006	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
B29007	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	
B29010	1	0	0
B29011	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	
B29012	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
B29013	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	
B29014	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	

	113_04	120_04	128_04	141_04	173_04	184_04	190_04	213_04	236_04	237_04	249_04	272_04	276_04	291_04	295_04	321_04	324_04	327_04	333_04	342_04	347_04	355_04	359_04	483_04	89_05	97_05	101_05	113_05	117_05	
B2203	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	0	0
B2204	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2205	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2206	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2207	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	1	0
B2208	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B2209	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	1
B2210	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2211	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B2212	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B2213	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B2214	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	0	0
B2215	0	1	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	1
B2216	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B2217	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	1
B2218	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2219	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2220	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2221	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B2222	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2223	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2224	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B2225	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	1	0	0	0
B2226	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B28978	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B28979	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B28980	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B28981	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	1	1	1	1	0	0
B28982	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	1	0	0	1	1	1	1	1	0	0	0
B28983	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0
B28986	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B28987	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	0	0	0
B28988	0	0	1	1	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0
B28989	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B28990	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1	0	0
B28991	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	0	1	0	0
B28992	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	1	0	1	0	1	0	0	0
B28993	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B28994	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B28995	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B28996	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	1	1	1	1	0	0
B28997	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B28998	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	1	1	1	0	0	0	0
B28999	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B29000	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B29001	0	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0
B29002	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	0	1	0	0
B29003	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B29004	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B29005	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B29006	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B29007	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B29010	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0
B29011	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	1	1	.	.	.	.	.
B29012	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B29013	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0
B29014	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0

	121_05	137_05	139_05	142_05	144_05	162_05	176_05	180_05	238_05	240_05	250_05	255_05	258_05	262_05	269_05	279_05	298_05	307_05	309_05	338_05	349_05	96_09	102_09	108_09	112_09	129_09	131_09	132_09	140_09		
B2203	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0		
B2204	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	1	0	0	
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B2206	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0
B2207	1	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0
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B2211	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	
B2212	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	
B2213	0	0	0	1	1	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	
B2214	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	
B2215	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	
B2216	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	
B2217	0	0	0	1	0	1	1	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	
B2218	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	
B2219	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	
B2220	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	1	
B2221	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	
B2222	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	
B2223	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	
B2224
B2225	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	
B2226	0	1	0	1	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
B28978	1	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	
B28979	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	
B28980	0	0	1	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
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B28982	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1	
B28983	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	
B28986	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	
B28987	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	
B28988	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
B28989	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	
B28990	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	1	0	0	1	
B28991	1	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	
B28992	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1	
B28993	0	0	0	0	1	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
B28994	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
B28995	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	
B28996	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	
B28997	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	
B28998	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
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B29001	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
B29002	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0	1	
B29003	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	
B29004	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	
B29005	0	0	1	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	
B29006	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
B29007	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	
B29010	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	
B29011	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
B29012	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
B29013	0	0	0	1	0	1	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
B29014	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	

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B2203	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	0	0
B2204	0	1	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	0	0
B2205	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0
B2206	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B2207	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	0	0	1	0
B2208	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B2209	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0
B2210	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B2211	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	1	0
B2212	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	1	1	0	0	0	0	0	0	1	0
B2213	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0
B2214	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B2215	0	1	1	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B2216	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0
B2217	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0
B2218	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B2219	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B2220	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	1	0	0	0	1	1	0	0	0	1	0	1	0	0
B2221	0	1	0	1	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	1	0
B2222	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	0	1	0	0
B2223	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B2224	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0
B2225	0	1	1	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B2226	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B28978	0	1	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0
B28979	0	1	1	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28980	0	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28981	0	1	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28982	0	1	0	0	1	0	0	0	0	0	1	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	1	0
B28983	0	1	1	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	0	1	1	0	0	1	0	0	1	0	0
B28986	0	1	0	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28987	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28988	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28989	0	1	1	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28990	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28991	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28992	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28993	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	1	0
B28994	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	1	0
B28995	0	1	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0	0	1	0	0
B28996	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B28997	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	1	0	0	0	1	0	1	0	0
B28998	0	1	0	0	1	0	1	0	0	0	1	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	1	0
B28999	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B29000	0	1	0	0	1	1	0	1	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B29001	0	1	0	0	0	1	0	0	0	0	0	1	1	0	1	0	0	0	0	1	1	0	0	1	0	0	1	0	0
B29002	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	1	0
B29003	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B29004	0	1	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B29005	0	1	0	0	0	0	1	0	0	0	0	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B29006	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B29007	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0
B29010	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0	0	1	0	0
B29011	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B29012	0	1	0	0	1	0	1	0	0	0	1	1	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	1	0
B29013	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	0	0	1	0	0
B29014	0	1	1	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0

	198_13	205_13	211_13	212_13	220_13	235_13	240_13	255_13	256_13	258_13	263_13	264_13	308_13	317_13
B2203	0	1	0	0	0	0	1	1	0	0	0	0	0	1
B2204	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2205	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2206	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2207	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2208	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2209	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2210	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2211	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2212	0	1	0	0	0	0	1	1	0	1	0	0	0	1
B2213	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2214	0	1	0	0	0	0	1	1	0	0	1	0	1	0
B2215	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2216	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2217	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2218	0	1	0	0	0	0	1	1	0	0	1	0	0	0
B2219	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2220	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2221	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2222	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2223	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B2224	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2225	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B2226	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B28978	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28979	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28980	0	1	0	0	0	0	1	1	0	0	0	0	0	1
B28981	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28982	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28983	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28986	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28987	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28988	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28989	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28990	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28991	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28992	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28993	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28994	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28995	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28996	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28997	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28998	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B28999	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B29000	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B29001	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B29002	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B29003	0	1	0	1	0	1	1	0	0	1	0	0	0	1
B29004	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B29005	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B29006	0	1	0	0	0	0	1	1	0	0	1	0	0	1
B29007	0	0	1	0	0	0	1	1	0	0	1	0	0	1
B29010	0	1	0	0	0	0	1	1	0	0	1	0	0	0
B29011	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B29012	0	1	0	0	0	0	1	1	0	0	1	0	0	0
B29013	0	1	0	0	0	0	1	1	0	0	1	0	0	0
B29014	0	1	0	0	0	0	1	1	0	0	1	0	0	0

	97_01	112_01	140_01	142_01	151_01	152_01	169_01	173_01	176_01	181_01	185_01	186_01	195_01	204_01	236_01	240_01	246_01	262_01	275_01	296_01	313_01	350_01	377_01	393_01	91_02	99_02	100_02	106_02	108_02			
B29015	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1			
B29016	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0	0	1	0	1		
B29017	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0	1	0	1	
B29018	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0	1	0	1			
B29019	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1			
B29020	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	1	0	1			
B29021	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1			
B29022	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	1	0	1	0	1			
B29023	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1			
B29024	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1			
B29025	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1			
B29026	1	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1		
B29027	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1		
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B29029	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1		
B29030	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1		
B29031	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1		
B29032	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1		
B29033	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1		
B29034	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0	1	0	1		
B29035	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1		
B29036	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1		
B29037	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0	1	0	1		
B29038	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	1	0	1	0	1		
B29039	1	0	0	0	0	0	0	0	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1		
B29040	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1		
B29041	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	
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B29044	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	1	0	1	0	1		
B29045	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	1	0	1	0	1		
B29046	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1		
B29047	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1		
B29048	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1		
B29049	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	
B29050	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1		
B29051	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1		
B29052	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	0	1	0	1		
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B29055	1	1	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	1	1	0	1	0	1		
B29056	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1		
B29057	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1		
B29058	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0	1	0	1		
B29059	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	
B29060	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1
B29061	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	1
B29062	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1
B29063	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	1
B29064	1	1	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	1	0	0	0	0	0	1	
B29065	1	1	0	0	0	0	0	0	1	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	1	0	1
B29066	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	1
B29068	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	1	0	0	0	0	0	1	0	0	1	0	1	0	1
B29069	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	1

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B29015	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1	0	0	0	
B29016	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	
B29017	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	
B29018	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
B29019	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29020	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29021	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29022	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
B29023	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
B29024	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1	0	0	0	
B29025	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29026	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29027	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29028	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29029	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29030	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29031	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29032	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29033	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	
B29034	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	
B29035	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	
B29036	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	
B29037	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
B29038	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	
B29039	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29040	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
B29041	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29042	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29043	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29044	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29045	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
B29046	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29047	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29048	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29049	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29050	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29051	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29052	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29053	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29054	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29055	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
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B29057	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29058	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29059	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
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B29062	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29063	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
B29064
B29065	0	0	0	0	1	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	
B29066	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
B29068	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	
B29069	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	

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B29015	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0		
B29016	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0		
B29017	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0		
B29018	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	
B29019	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
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B29068	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	
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B29057	0	1	1	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
B29058	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
B29059	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
B29060	0	1	1	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
B29061	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
B29062	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
B29063	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
B29064	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0
B29065	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	
B29066	0	1	0	0	1	0	1	0	0	0	0	1	0	0	1	
B29068	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	0	1	0	0	
B29069	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	0	1	0	0	

Table S3. AFLP primer pairs

	<i>TaqI</i>							
<i>EcoRI</i>	AAC	AAG	ACA	ACT	AGA	AGT	ATC	ATG
AAC, 6-FAM	01	02	03	04	05	06	07	08
AAG, Hex	09	10	11	12	13	14	15	16

This table shows the PCR primers with the selective bases added to reduce the number of fragments.

Primer pairs used in this study were: 01, 02, 03, 04, 05, 09, 10, 11, 12, 13.

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