

# Phylogenetic Relationships of the Phasianidae Reveals Possible Non-Pheasant Taxa

K. L. BUSH AND C. STROBECK

From the Department of Biological Sciences, University of Alberta–Edmonton, Edmonton, Alberta T6G 2E9, Canada.

Address correspondence to Krista Bush at the address above, or e-mail: kbush@ualberta.ca.

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## Abstract

The phylogenetic relationships of 21 pheasant and 6 non-pheasant species were determined using nucleotide sequences from the mitochondrial cytochrome *b* gene. Maximum parsimony and maximum likelihood analysis were used to try to resolve the phylogenetic relationships within Phasianidae. Both the degree of resolution and strength of support are improved over previous studies due to the testing of a number of species from multiple pheasant genera, but several major ambiguities persist. *Polyplectron bicalcaratum* (grey peacock pheasant) is shown not to be a pheasant. Alternatively, it appears ancestral to either the partridges or peafowl. *Pucrasia macrolopha macrolopha* (koklass) and *Gallus gallus* (red jungle fowl) both emerge as non-pheasant genera. Monophyly of the pheasant group is challenged if *Pucrasia macrolopha macrolopha* and *Gallus gallus* are considered to be pheasants. The placement of *Catreus wallichii* (cheer) within the pheasants also remains undetermined, as does the cause for the great sequence divergence in *Chrysolophus pictus obscurus* (black-throated golden). These results suggest that alterations in taxonomic classifications may be required for some pheasant species and genera.

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Pheasants are one of the most endangered groups of birds in the world. A total of 27 species appear on the most recent Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) list, with 17 of these classified as CITIES I (Appendix A species are either rare or endangered; CITES 2001). In the last 150 years, several pheasant species and subspecies have virtually disappeared, with few birds left in the wild and limited breeding stock in captivity. Game birds are some of the most widely kept birds in captivity, with pheasants making up a large percentage of that total (Beebe 1990a,b). However, we have very little understanding of this group. Accurate evolutionary and taxonomic information is essential for developing appropriate CITES classifications and for the management of threatened species.

What exactly is a pheasant? To date, the boundaries that define pheasants have not been satisfactorily determined. Pheasants (Phasianidae) are generally thought to be comprised of three subfamilies: Tragopaninae (tragopans), Argusianinae (Argus pheasants), and Phasianinae (pheasants) (Amador 1999). Tragopaninae is comprised of a single genus that consists of the five tragopan species and Argusianinae is made up of three genera: *Polyplectron* (peacock pheasants), *Rheinartia* (crested Argus), and *Argusianus* (great Argus; Amsdor 1999; Beebe 1990a,b). Phasianinae is much more diverse and encompasses 10 different genera: *Ithaginis* (blood

pheasants), *Pucrasia* (koklass), *Lophophorus* (monal pheasants), *Gallus* (jungle fowl), *Lophura* (Gallo pheasants), *Crossoptilon* (eared pheasants), *Catreus* (cheer), *Syrnaticus* (long-tailed pheasants), *Phasianus* (true pheasants), and *Chrysolophus* (ruffed pheasants; Amador 1999; Beebe 1990a,b). This is, however, a mainly arbitrary classification used to group together genera that are similar in body form and behavior.

Prior to the development of sequencing data and molecular techniques, morphological, geographical, and behavioral characteristics were used to classify pheasants. Most of the field research and classification of pheasants was performed in the first half of the 20th century by William Beebe and Jean Delacour. Their numerous books and articles are still the best accounts of pheasants in the wild and most of their classifications of genera and species remain unchanged. The only novel work on the classification of pheasants since that time is Johnsgard's (1986) *Pheasants of the World*, which outlines his postulated evolutionary relationships within Phasianidae based on developmental, behavioral, and physical observations.

There have been several recent attempts to reconstruct the phylogenetic relationships of the Phasianidae, but a comprehensive study including all three subfamilies (Tragopaninae, Argusianinae, and Phasianinae; Amsdor 1999) has not been attempted. The present study was inspired by Kimball et al. (1999), who examined the

**Table 1.** Species examined and source of sequence data

Family	Subfamily	Genus	Species and common name	Source of cytochrome <i>b</i> GenBank accession no.			
Cracidae		<i>Ortalis</i>	<i>Ortalis vetula</i> (plain chachalaca)	L08384			
Phasianidae	Perdicinae	<i>Alectoris</i>	<i>Alectoris chukar</i> (chukar partridge)	L08378			
			<i>Alectoris philbyi</i> (Philby's rock partridge)	Z48774			
	Afropavoninae	<i>Afropavo</i>	<i>Afropavo congensis</i> (Congo peafowl)	AF013760			
	Pavoninae	<i>Pavo</i>	<i>Pavo cristatus</i> (India blue peafowl)	L08379			
	Tragopaninae	<i>Tragopan</i>	<i>Tragopan caboti</i> (Cabot's tragopan)	AF534554 <sup>a</sup>			
			<i>Tragopan satyra</i> (satyr tragopan)	AF534555 <sup>a</sup>			
			<i>Tragopan temminckii</i> (Temminck's tragopan)	AF028802			
			Argusianinae	<i>Polyplectron</i>	<i>Polyplectron bicalcaratum</i> (grey peacock)	AF534564 <sup>a</sup>	
			Phasianinae	<i>Chrysolophus</i>	<i>Chrysolophus pictus</i> (red golden)	AF028793	
					<i>Chrysolophus pictus obscurus</i> (black-throated golden)	AF534563 <sup>a</sup>	
					<i>Chrysolophus pictus infuscatus</i> (yellow golden)	AF534562 <sup>a</sup>	
					<i>Crossoptilon</i>	<i>Crossoptilon auritum</i> (blue-eared)	AF534552 <sup>a</sup>
					<i>Crossoptilon mantchuricum</i> (brown-eared)	AF534553 <sup>a</sup>	
					<i>Crossoptilon crossoptilon drouyni</i> (white-eared drouyni)	AF534556 <sup>a</sup>	
	<i>Crossoptilon crossoptilon crossoptilon</i> (white-eared Szechuan)	AF028794					
	<i>Catreus</i>	<i>Catreus wallichii</i> (cheer)			AF028792		
	<i>Lophura</i>	<i>Lophura edwardsi</i> (Edwards)			AF534557 <sup>a</sup>		
		<i>Lophura swinhoii</i> (Swinhoe)			AF534558 <sup>a</sup>		
	<i>Syrmaticus</i>	<i>Syrmaticus ellioti</i> (Elliot)	AF534559 <sup>a</sup>				
		<i>Syrmaticus humiae humiae</i> (Humes bartail)	AF534560 <sup>a</sup>				
<i>Syrmaticus mikado</i> (Mikado)		AF534561 <sup>a</sup>					
<i>Syrmaticus reevesi</i> (Reeves)		AF028801					
<i>Phasianus</i>	<i>Phasianus colchicus torquatus</i> (ringneck)	AF028798					
<i>Lophophorus</i>	<i>Lophophorus impeyanus</i> (Impeyan)	AF028796					
<i>Pucrasia</i>	<i>Pucrasia macrolopha macrolopha</i> (koklass)	AF028800					
<i>Gallus</i>	<i>Gallus gallus</i> (red jungle fowl)	AF028795					

<sup>a</sup> Species sequenced in this study (GenBank accession nos. AF534552–AF534563).

molecular phylogeny of pheasants and partridges. Their main goal was to determine whether these subfamilies are monophyletic. They sequenced the complete cytochrome *b* gene of various species from multiple genera of Galliformes, but sampled only one species from each genus of pheasants commonly found in captivity (Kimball et al. 1999). We decided to sequence the cytochrome *b* region of all pheasant species readily available in Canada in order to try to further resolve their phylogenetic relationships.

The primary goal of this study was to ascertain the evolutionary relationships among the different species of pheasants and to determine whether the current taxonomic classification is correct or needs to be revised. Other secondary considerations were to determine if the pheasant group is monophyletic (do all of the members of this group share a common ancestor and does that ancestor only give rise to members of the named taxon), which has been disputed in several previous studies (Crowe et al. 1992; Kimball et al. 1999; Randi 1996; Randi et al. 1991). A final goal was to determine if the grey peacock pheasant is a pheasant or a peafowl. It shares characteristics with both groups, but is traditionally classified as a pheasant because of its geographic range and morphological features.

The cytochrome *b* gene of 29 Phasianidae species commonly bred in Canada was sequenced (Table 1). Cytochrome *b* has been used in numerous studies of the phylogeny of pheasants along with other groups within Phasianidae (Akishinomiya 1995; Birt et al. 1992; Bloomer

and Crowe 1998; Crowe et al. 1992; Kimball et al. 1997, 1999; Randi 1996; Randi et al. 2000). This facilitates comparisons with previous work. There have also been numerous studies which have used the mitochondrial cytochrome *b* gene to study phylogenetic relationships within the order Galliformes and in other avian lineages (Bensch and Harlid 2000; Mindell et al. 1997, 1998; Miyaki et al. 1998; Moore and DeFilippis 1997; Nunn et al. 1996; Van Tuinen et al. 2000).

## Methods

### Molecular Techniques

Blood or pinfeather samples were collected from representative individuals of 29 species and subspecies of pheasants (Table 1) from private collections in Canada. Individuals were determined as representative of the species if they conformed to the descriptions outlined by Beebe (1990a,b). These descriptions are of birds from wild populations in their natural environment (Beebe 1990a,b). Blood was taken from the vein at the base of the wing and the pinfeathers or primary feather number nine was pulled from the wing early in the fall before the feather aged and the blood supply dried up. DNA was extracted using a QIAamp DNA Blood Mini Kit for each species according to manufacturer's specifications (QIAamp 1999). The mitochondrial cytochrome *b* region was amplified by polymerase chain reaction

**Table 2.** Amplification and sequencing primers for cytochrome *b*

Name and primer set no. <sup>a</sup>	Sequence (5' → 3')	Source
1) L14731	ATCGCCTCCCACCT(AG)AT(CG)GA	Kimball et al. (1999)
2) L14851	TACCTGGGTTCCCTTCGCCCT	Kornegay et al. (1993)
3) PHES LOWER INT 1	ATGAGGTGGAGGTTGGCAAGG	This study <sup>b</sup>
3) PHES UPPER INT 1	TAGTATGGGTGAAATGGGAT	This study <sup>b</sup>
2) H15826	CGGAAGGTTATGGTTCGTTGTTT	Kimball et al. (1999)
1) H16065	TTCAGTTTTTGGTTTACAAGAC	Modified (Kimball et al. 1999), Kornegay et al. (1993)

<sup>a</sup> Numbers before primer name indicate which primer set they belong to (1, 2, or 3).

<sup>b</sup> Primers designed in this study as light-strand or heavy-strand internal primers.

(PCR) for one individual of each species (Table 2; Kimball et al. 1999). Two different primer sets (each consisting of a heavy and light strand primer) amplified either a 1334 bp (H16065, L14731) or 975 bp (H15826, L14851) region of cytochrome *b*. Primer set 1 (1334 bp; H16065, L14731) amplified the end of ND5, cytochrome *b*, and part of tRNA-Thr posterior to the cytochrome *b* gene (Sorenson et al. 1999). Primer set 2 (975 bp; H15826, L14851) amplified an internal segment of the cytochrome *b* gene and was only used in cases where primer set 1 did not work. The PCR mix for primer set 1 contained 60.5 µl of distilled water, 8 µl of 2 mM dNTPs, 12 µl of 25 mM MgCl<sub>2</sub>, 10 µl of 10× PCR buffer, 2.5 µl of 1/5 *Taq* polymerase, 5 µl of template, and 1 µl of each primer. The PCR mix for primer set 2 contained 61 µl of distilled water, 9 µl of 2 mM dNTPs, 12 µl of 25 mM MgCl<sub>2</sub>, 10 µl of 10× PCR buffer, 1 µl of 1/5 *Taq* polymerase, 5 µl of template, and 1 µl of each primer. PCRs were performed on a PE 9600 thermocycler under the following conditions: 94°C for 3 and 45 cycles of 94°C for 1 min, 45°C for 1 min, 72°C for 1 min and 30 s. Resulting PCR fragments were resolved on 0.8% agarose gels followed by gel purification with a QIAquick Gel Extraction Kit. Fragments were sequenced using a Big Dye Terminator sequencing mix and resolved on an ABI 377 automated DNA sequencer. Four sequencing primers allowed for the sequencing of the 975 bp or 1334 bp fragment from both directions. Neither of the two original primer sets allowed us to sequence the full cytochrome *b* gene, so internal primers had to be created. The light-strand internal and heavy-strand internal primers were designed using the Oligo 5.1 primer design program (Table 1).

Of 29 original species, the complete cytochrome *b* gene was sequenced for 14 species. Of the 15 species that were not included, 5 would not amplify with the available primers, 9 amplified and were sequenced but contained large numbers of ambiguities between the heavy and light strands and were therefore excluded, and 1 was complete but contained numerous large deletions or gaps throughout and was excluded. Sequence for most of the species that could not be sequenced, along with a few non-pheasant taxa, were taken from GenBank (Kimball et al. 1999) (Table 1).

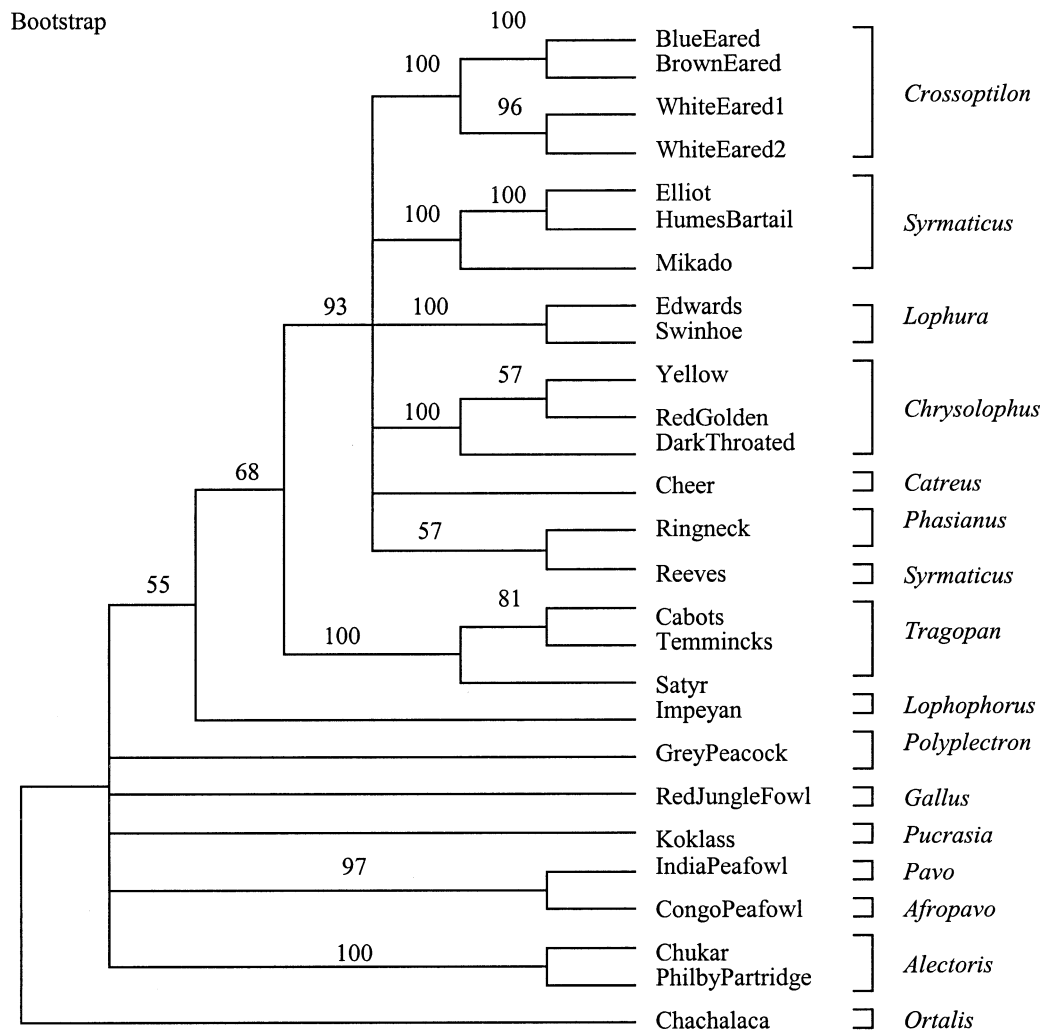
### Phylogenetic Analysis

The sequence of each species was reconstructed individually from the different sequencing reactions and was then aligned

as a contig in Sequence Navigator (ABI). Large regions before the cytochrome *b* gene and a small segment after were deleted, making all sequences a uniform 1143 bp for the 27 species of the analysis (Table 1). The alignment was then put into a matrix where further manual alignment corrections were made (Appendix A). Analysis of this matrix was performed in PAUP using three common methods of phylogenetic analysis: maximum parsimony, maximum likelihood, and neighbor joining. These were first used with the software default settings (which correspond to equally weighted parsimony and maximum likelihood with the Jukes and Cantor model; Jukes and Cantor 1969). Maximum parsimony and maximum likelihood trees were rooted with *Ortalis vetula* (chachalaca) as an outgroup. It was chosen according to classical taxonomic and recent molecular data that suggest they are outgroups to the pheasants (Kimball et al. 1999).

A consensus tree was made for the maximum parsimony analysis using majority rule (50%; Hillis and Bull 1993). To test the reliability of specific clades in the parsimony trees, bootstrapping was performed (Hillis and Bull 1993). Both 100 and 1000 replicates were used to estimate the bootstrap proportions in parsimony analysis with 10 random addition sequence replicates for each bootstrap replicate. It has been suggested that as long as the method used to estimate phylogenetic relationships is consistent in the statistical sense, the bootstrap proportion is a conservative assessment of the probability that a clade is correct (Milinkovitch et al. 1996). In this analysis, all values less than 60% are considered least reliable, as these groups were the least stable (Figure 1). A well-supported clade was defined as a bootstrap proportion of ≥70% (Kimball et al. 1999).

Weighted parsimony was tried because this method is often accepted as being more representative of the mode of evolution of protein coding sequences (Hillis and Bull 1993; Mindell and Thacker 1996). It is also thought to yield more accurate results, but only when the weights are known (Hillis and Bull 1993; Mindell and Thacker 1996). Since no previous studies using pheasant cytochrome *b* have included weighting, we chose weights appropriate for mammalian cytochrome *b* (position 1 = 4, position 2 = 15, and position 3 = 1; Irwin et al. 1991). Other weights were attempted to evaluate how much each codon position substitution influences the topology of the tree. This analysis required constraints to force *Ortalis vetula* (chachalaca) to stay as an outgroup. Since it



**Figure 1.** Majority rule tree from two equally parsimonious trees. Numbers are percentage bootstrap support. No numbers are given if the bootstrap values are less than 50%.

is well accepted that chachalaca is an outgroup from traditional classification and molecular studies (Kimball et al. 1999), it was justifiable to set a constraint.

Maximum likelihood analysis was used to estimate the following parameters for a preliminary dataset (22 pheasant species): base frequency, transition:transversion ratio, and number of substitution types. These numbers were then substituted for the defaults in the likelihood settings to a model corresponding to the HKY+ gamma model and another heuristic search was initiated. Estimated maximum likelihood trees had to be constrained for the same reasons as stated above. The Kishino and Hasegawa test was performed to determine whether the topologies of the estimated maximum likelihood tree and the constrained estimated likelihood tree were significantly different (Lewis 1999). This test yielded a result showing that these two trees are not significantly different, indicating that the data could not distinguish between them (Lewis 1999). A final heuristic search was initiated (including all 27 species) with all

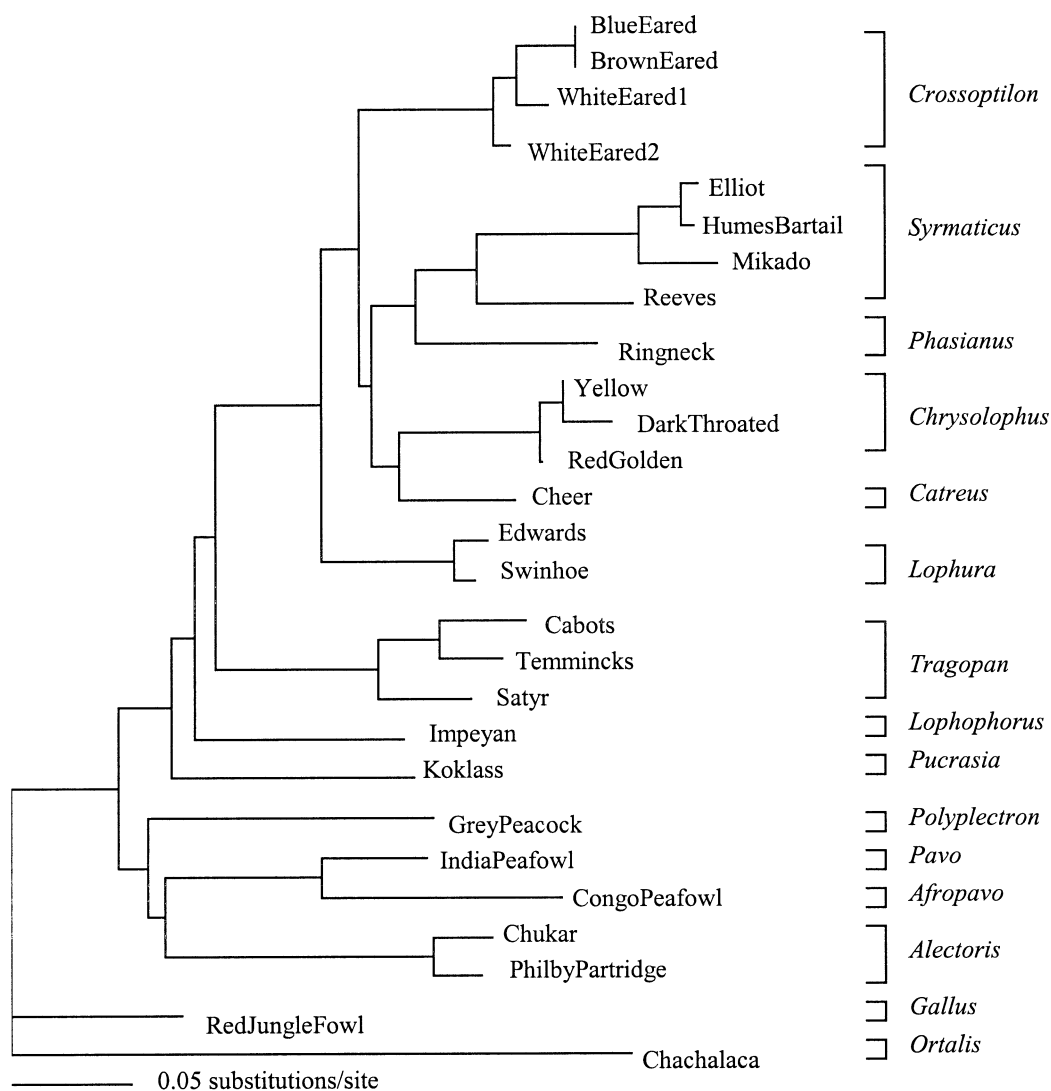
parameters estimated. The score of the best tree found was 7882.00887 (Figure 2). This maximum likelihood tree had estimated base frequencies of A: 0.294263, C: 0.373515, G: 0.095742, and T: 0.236481 and an estimated transition:transversion ratio of 4.161106 ( $\kappa = 8.497097$ ).

Neighbor-joining trees were all performed using default settings and were unrooted. This tree, along with the maximum parsimony and maximum likelihood tree, were used to construct a consensus tree (data not shown).

## Results

### Cytochrome *b*

The cytochrome *b* gene of all species sequenced, with the exception of the white ringneck, matched other pheasant sequences obtained from GenBank (Kimball et al. 1999), confirming that the gene sequenced was cytochrome *b*. Kimball et al. (1999) identified heme-ligating histidines and other conserved residues which indicated that the region



**Figure 2.** Maximum likelihood tree identified using cytochrome *b* nucleotide data; ln likelihood = 7882.00887.

sequenced was the functional cytochrome *b* gene and not a pseudogene (Kimball et al. 1999). Nuclear pseudogenes (numts) are known to accumulate mutations in otherwise highly conserved regions (Quinn 1997; Sorenson and Quinn 1998), making them relatively easy to identify from the functional gene (Kimball et al. 1999). Branch lengths of pseudogenes are also longer on average than those of a functional gene (Quinn 1997; Sorenson and Quinn 1998). Comparative analysis of mitochondrial-rich tissue samples and blood yielded no difference in branch lengths, suggesting that both samples yield the functional mitochondrial gene (Kimball et al. 1999).

There may be one example of a pseudogene present in this study. The white ringneck sequence consisted of multiple deletions of varying sizes and amino acid substitutions in the anterior half of the gene, but the posterior half matched the sequence of the other pheasant species fairly consistently. It was the only species completely

sequenced by the second primer set. If these primers were developed as “universal primers,” there may have been preferential amplification of a nuclear sequence of mitochondrial origin (Sorenson et al. 1999). This sequence also displayed double peaks for the sequence amplified by the heavy primer, which is consistent with nuclear and mitochondrial products being amplified by PCR (Randi et al. 2001).

**Phylogenetic Analysis**

Mitochondrial DNA has been shown to have a very high transition:transversion ratio (Kimball et al. 1999). The estimated transition:transversion ratio of 4.161106 to 1 in this study (Figure 2) and 3.8 in that of Kimball et al. 1999 are most likely close to the minimum transition:transversion ratio, as maximum likelihood may underestimate this ratio for mitochondrial DNA. Transition:transversion ratios of

**Table 3.** Johnsgard's (1986) four proposed major lineages of pheasants

Lineage	Genera included
Gallo pheasants and their allies	<i>Phasianus</i> <i>Syrnaticus</i> <i>Catreus</i> <i>Chrysolophus</i> <i>Lophura</i> <i>Crossoptilon</i>
Tragopans and their allies	<i>Tragopan</i> <i>Ithaginis</i> <i>Pucrasia</i> <i>Lophophorus</i>
Jungle fowl	<i>Gallus</i>
Peafowl and their allies	<i>Pavo</i> <i>Afropavo</i> <i>Argusianus</i> <i>Rheinartia</i> <i>Polyplectron</i>

both 3.812 (Kimball et al. 1999) and 10 (Kimball et al. 1997, 1999) were tried in this study with little difference in the results.

#### Relationships within the Pheasants

The four major lineages of pheasants proposed by Johnsgard (1986; Gallo pheasants and their allies, tragopans and their allies, jungle fowl, and peafowl and their allies; Table 3) are somewhat supported by this study, but with branch orders differing from the postulated evolutionary relationships. Several genera (*Gallus*, *Polyplectron*, and *Pucrasia*) also have considerably different placement from Johnsgard's postulated tree. The tree shown in Figure 2 was obtained using estimated maximum likelihood methods, while the topology represented in Figure 3 was acquired through weighted parsimony methods. Many groups stay constant throughout both forms of analysis, but four species, the cheer, red jungle fowl, koklass, and grey peacock, are highly variable in their placement.

*Crossoptilon* is the best supported clade in this analysis, with all four species always grouping together. An interesting observation is that the blue eared and brown eared have identical cytochrome *b* sequences. A sequencing or matrix construction error can be ruled out as, upon review of both sequences, there are differences outside the cytochrome *b* gene that were cut off for purposes of this analysis.

Three *Syrnaticus* species (*elliotti*, *humiae*, and *mikado*) are another well-supported clade. Both *humiae* and *elliotti* were classified as barred-back pheasants by Beebe (Beebe 1990b) and the males are described as having a similar appearance (Delacour 1977), supporting their position as sister species. Since the mikados share most characteristics with the other two species, it is not surprising that they are a member of this clade. The reeves and ringneck group is also a strongly supported clade, but traditionally reeves are classified as *Syrnaticus* and the ringneck as *Phasianus* (Beebe 1990a,b; Delacour 1977; Johnsgard 1986). When this set does not pair

with the cheer, they pair with the *Syrnaticus* as basal species in that clade (Figure 2).

Edwards and Swinhoe, two *Lophura* species in this study, are a very well-supported clade in all forms of analysis (Figures 1–3). These findings are verified in a study examining the phylogenetic relationships of 10 species of *Lophura* (Randi et al. 2001).

The three *Chrysolophus* species also form a clade. Both the yellow golden and the black throated golden are reported to be recent color mutations of the red golden (Allen 1966; Delacour 1977; Ghigi 1966) and therefore all three should have great sequence similarity and should be the same species. Both the yellow and black throated goldens appear as offshoots of the red golden with the yellow golden, showing no change from the time it diverged in 1952 (Allen 1966; Delacour 1977; Ghigi 1966) (Figures 2 and 3). The black throated golden on the other hand shows considerable divergence from its common ancestor with the red golden (26 bp changes). This is a great deal of change to have occurred in the past 137 years.

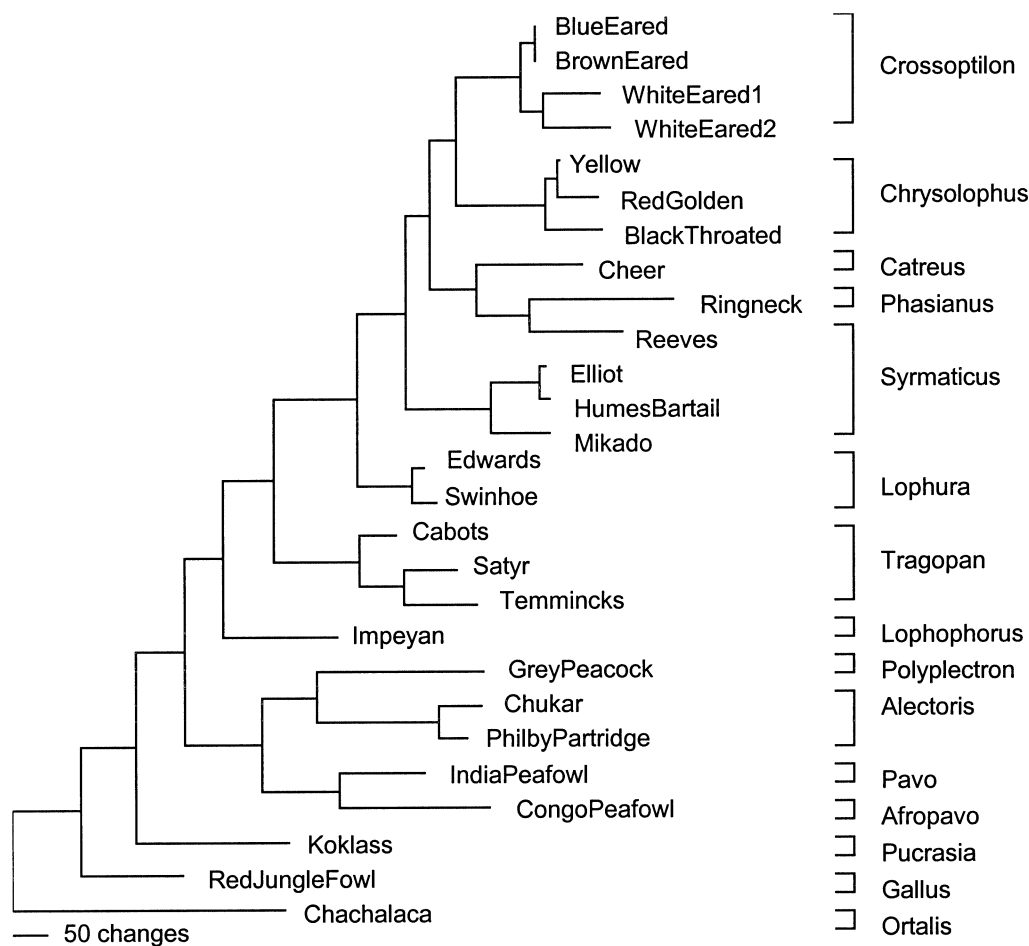
The three tragopan species form a clade in all forms of analysis, but the relationships within the clade are only weakly supported. In the maximum likelihood tree, the Satyrs are the sister group of the Cabots and Temmincks (Figure 2), which is consistent with a study examining the phylogeny and speciation of the tragopans (Randi et al. 2000). Weighting the data for codon position in maximum parsimony causes the Temmincks and Satyrs to group together, with the Cabots as the sister taxa (Figure 3). The first results are consistent with species feather markings and geographic ranges, considering both Temmincks and Cabots are found on the east side of the Himalayas and Satyrs are found on the west side (Beebe 1990a; Delacour 1977; Johnsgard 1986; Randi et al. 2000).

The only extant *Catreus* species, the cheer, appears as a sister taxa of *Chrysolophus* when likelihood analysis or unweighted parsimony is performed (Figure 2). Weighting the bases causes cheer to relocate and become the sister taxa of the ringneck-reeves group (Figure 3). Traditionally cheer has been placed in a position between *Chrysolophus* and *Syrnaticus*, which is where the bootstrapping analysis places it, so this study has not further resolved their placement.

*Gallus* is traditionally placed within the pheasants, but that position is disputed by the results of this study. When bootstrapping is performed, the red jungle fowl is located outside of the pheasant lineage between the grey peacock and the koklass. Both maximum likelihood and parsimony place the red jungle fowl as the sister species to the outgroup.

The placement of *Pucrasia macrolopha* in this study is the most varied of any species in this study. When maximum likelihood is performed (Figure 2), the koklass is placed as the most basal pheasant. For maximum parsimony analysis (Figure 3), it groups outside of the pheasants and becomes an archaic lineage that diverged prior to peafowl and partridge. Bootstrapping places the koklass as a species peripheral to the pheasants, along with the grey peacock and red jungle fowl.

The grey peacock is another species that changes its location in the different modes of phylogenetic analysis. In



**Figure 3.** Weighted maximum parsimony tree using cytochrome *b* nucleotide data; weights: 4, 15, 1.

the preliminary dataset comprised of only suspected pheasant species, the grey peacock is located as the peripheral pheasant when maximum likelihood is performed (data not shown), but is nested within the pheasants in the maximum parsimony tree (data not shown). When all 27 species were included and maximum likelihood was performed (Figure 2), the grey peacock groups as a peripheral member of the peafowl-partridge group. Weighted parsimony analysis (Figure 3) pairs the grey peacock with the partridge group. These results suggest that the grey peacock is not a pheasant.

### Discussion

The results of this study show that most of the previously defined pheasant species fall into the pheasant group with the exception of the grey peacock and perhaps the koklass and red jungle fowl. The position of cheer is variable within the pheasant group and therefore remains unresolved. Finally, whether or not pheasants are a monophyletic group depends on the status of koklass and red jungle fowl as pheasants and their placement in the tree relative to the other species.

### Placement of the Grey Peacock within Phasianidae

Traditional studies have placed the grey peacock with either the pheasants or the peafowl depending on the classification approach (Beebe 1990a,b; Delacour 1977; Johnsgard 1986). The peacock pheasants (genus *Polyplectron*) have always been classified as a pheasant because of their characteristics, but received the name peacock because of their eyed feathers and display (Bergmann 1980). The assignment of the grey peacock as a pheasant seems reasonable because of their behavior and appearance, but recent phylogenetic studies have placed them with the peafowl (Kimball et al. 1997, 1999; Kimball and Ligon 1999).

In the maximum likelihood tree (Figure 2), the grey peacock pairs as a sister taxa to the peafowl-partridge group. In the equally weighted maximum parsimony and constrained weighted parsimony trees (Figure 3), it groups with the two old-world partridges. Since the grey peacock is highly mobile, it cannot be ruled out as being a pheasant with any certainty, but it is becoming increasingly unlikely with the mounting evidence (Kimball et al. 1999; this study). It paired with both the partridges and the peafowl in this study, so a plausible alteration to the original question is that it may be a member of either group. Johnsgard (1986, 1988)

hypothesized that many or all of the typical pheasant lineages evolved from a partridge-like ancestor, but there are no data to support this. However, this theory may explain why a pheasant-like bird is grouping basally with the partridges. To determine whether the grey peacock belongs with the partridges or peafowl, more data are necessary. More species of peacock pheasants must be sequenced, along with more species of peafowl and partridge.

#### Placement of *Catreus wallichii* (Cheer) within the Pheasants

Cheer are a very unusual pheasant, therefore using morphological data to try resolve their placement is not very productive. They share characteristics with every group, but do not fall into any clear category historically because of their odd appearance and mix of morphological and behavioral traits. Both sexes are relatively similar with regard to appearance, which is unusual in the pheasants outside the eared, and they are both a very subdued sand color, which is uncharacteristic for male pheasants (Beebe 1990a,b; Delacour 1977). Perhaps due to their unusual characteristics, it is not surprising that cheer was highly mobile when different methods of analysis were used. Maximum likelihood resulted in the cheer pairing with the ruffed clade (Figure 2). When maximum parsimony is attempted with altered character weights, cheer pairs with the reeves and ringneck (Figure 3). Bootstrapping places them between the ruffed clade and the reeves-ringneck group (Figure 1). Unweighted parsimony places cheer with the red goldens and the white-eared pheasants (Kimball et al. 1999) or with the ruffed clade (data not shown). Again, more species and more genes are needed to resolve the phylogenetic relationships of the pheasants.

#### Placement of the Genus *Pucrasia* (Koklass) within Phasianidae

*Pucrasia* is a highly distinctive genus whose placement remains unresolved. Bootstrapping positions koklass basal to the monophyletic pheasant grouping (Figure 1). Maximum likelihood places them either as the most primitive pheasant or as the sister to the whole pheasant lineage (Figure 2). The most interesting placement occurs when maximum parsimony is attempted with altered character weights (Figure 3). The koklass becomes nested in the non-pheasant lineages as the sister species to all pheasants, peafowl, and partridges (Figure 3). These different placements within the tree raise questions as to whether the koklass is actually a pheasant, and if it is, are pheasants monophyletic? Due to the uncertainty of classifying either the grey peacock or the jungle fowl as pheasants, it makes it difficult to discern whether the koklass is a pheasant. With the present data (Figures 1–3), it is exceedingly unlikely that the koklass should be included with the pheasants, and therefore pheasants are likely monophyletic. Traditional classification considers the koklass to be a pheasant (Beebe 1990ab, Delacour 1977; Johnsgard 1986), causing a polyphyletic group to be created. More mitochon-

drial data, as well as nuclear markers, should be sequenced for all of the koklass species, along with other pheasant species, to try to determine the phylogenetic relationship of this genus.

#### Placement of the Genus *Gallus* within Phasianidae

*Gallus* is traditionally included with the pheasants in the subfamily Phasianinae (Amador 1999), however, in all forms of analysis they appear to be ancestral to the pheasant lineage. When bootstrapping is performed, the red jungle fowl is located between the monophyletic pheasant group and the partridge-peafowl group along with the grey peacock and koklass, whose placement also remains unresolved (Figure 1). In both the maximum likelihood and maximum parsimony trees (Figures 2 and 3), the red jungle fowl appears to be the sister group to the outgroup (the chachalaca). It is therefore likely that the genus *Gallus* is not a member of the pheasants, but rather had a basal ancestor. To try to further resolve their relationship, all three genera of *Gallus* need to be included in the analysis.

#### The Great Sequence Divergence of the Black-Throated Golden

The black-throated golden is thought to be a color mutation of the red golden pheasant first developed in 1865 (Allen 1966; Delacour 1977). Maximum likelihood analysis shows the black-throated golden diverging from the red golden along with the yellow golden (Figure 2). Both bootstrapping and maximum parsimony have the black-throated golden diverging from a common ancestor shared with the red golden, making them sister taxa (Figures 1 and 3). The likelihood tree is consistent with the classical idea of it being a color mutation, however, the degree of sequence divergence between the black-throated and red goldens (26 bp changes) is very unlikely to have developed in only 137 years.

There have been two schools of thought on the golden color varieties. The first and most popular is that they are all natural color mutations of the red golden (Allen 1966; Delacour 1977; Ghigi 1966), but there is no scientific literature detailing specific pedigrees to support this. The inheritance patterns outlined for the black-throated golden also do not conform to any known accepted inheritance patterns and the lineage does not consistently produce birds with black-throated characteristics. The second, and more probable theory, is that the black-throated golden is the result of selective crossbreeding with the Amherst pheasant. This theory is based on comparing feather patterns and colors of the Amherst with the black-throated which are not present on the red golden. Since we were unable to sequence any Amherst sample, we cannot support or disprove either hypothesis pertaining to the origination of the black-throated lineage. The full sequence of the Amherst and the salmon golden is needed to determine the placement of the black-throated golden, but presently neither has been obtained.



## Conclusion

The phylogeny of the three subfamilies (Tragopaninae, Argusianinae, and Phasianinae) of pheasants remains incompletely resolved. The placement of cheer within the group is uncertain and it is unclear whether the grey peacock, koklass, or red jungle fowl are pheasants. Since their respective positions were unstable, it cannot be ruled out that they are pheasants. However, the continued placement of the grey peacock with either *Pavoninae* or *Perdicinae* suggests it may be more likely that it is a peafowl or partridge.

To resolve these questions, longer mitochondrial sequences and other markers from all of the species studied need to be included, as well as information from other species.

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**Appendix Table A.** Alignment of cytochrome *b* sequences from members of the Galliformes

<i>Gallus gallus</i>	ATGGCACCCA	ACATTTCGAAA	ATCCCACCCC	CTACTAAAAA	TAATTAACAA	CTCCCTAATC
<i>Ortalis vetula</i>	●●●●●●●●	●●●●●●●●	●●●T●●●●●	●●●●●●●●	●●●●●●●●	●●●●●●●●
<i>Alectoris chukar</i>	●●●●●●●●	●T●●C●●●●	●●●G●●●●●	●●●T●●●●●	●●●G●C●●●●	●●●●T●●●●T
<i>Alectoris philbyi</i>	●●●●●●●●	●●●●C●●●●	●●●G●●●●●	●●●●●●●●	●●●G●●●●●●	●●●●T●●●●T
<i>Afropavo congensis</i>	●●●●●●●●	●●●●C●●●●	●●●T●●●●●	●●●T●●●●●	●●●●●●●●	●●●T●●T●●●
<i>Pavo cristatus</i>	●●●●●●●●	●●●●C●●●●	●●●●●●●●	●●●●●●●●	●●●●C●●●●	●●●●●●●●
<i>Polyplectron bicalcaratum</i>	●●●●●●●●	●●●●C●●●●	●●●●●●●●	●●CT●●●●●	●●●●●●T●●	●●●●●●●●T
<i>Pucrasia macrolopha</i>	●●●●●●●●	●●●●C●●●●	●●●A●●●●●	●●TT●●●●●	●●●C●●●●●	●●●T●●●●●
<i>Lophoborus impeyanus</i>	●●●●●●●●	●●●●C●●●●	●●●A●●●●●	●●G●●●●●●	●●●●●●T●●	●●●●●●●●T
<i>Crossoptilon auritum</i>	●●●●●●●●	●●●●C●●●●	●●●A●●●●●	●●●●●●●●	●●●●C●●T●●	●●●●●●●●
<i>Crossoptilon mantchuricum</i>	●●●●●●●●	●●●●C●●●●	●●●A●●●●●	●●●●●●●●	●●●●C●●T●●	●●●●●●●●
<i>Crossoptilon c. drouyni</i>	●●●●●●●●	●●●●C●●●●	●●●T●●●●●	●●●●●●●●	●●●●C●●T●●	●●●●●●●●
<i>Crossoptilon c. crossoptilon</i>	●●●●●●●●	●●●●C●●●●	●●●T●●●●●	●●●●●●●●	●●●●C●●T●●	●●●●●●●●
<i>Tragopan caboti</i>	●●●●●●●●	●●●●C●●●●	●●●A●●●●●	T●●●●●●●●	●●●C●●T●●	●●●T●●C●●●
<i>Tragopan satyra</i>	●●●●●●●●	●●●●●●C●●	●●●A●●●●●	●●●●●●●●	●●●C●●T●●	●●●T●●C●●●
<i>Tragopan temminicki</i>	●●●●●●●●	●●●●C●●●●	●●●A●●●●●	T●G●●●●●●	●●●C●●T●●	●●●●●●●●
<i>Lophura edwardsi</i>	●●●●●●●●	●T●●C●●●●	●●●A●●●●●	●●●●●●●●	●●●C●●T●●	T●●●●●●●T
<i>Lophura swinhoii</i>	●●●●●●●●	●T●●C●●●●	●●●A●●●●●	●●●●●●●●	●●●C●●T●●	T●●●●●●●T
<i>Syrnaticus ellioti</i>	●●●●●●●●	●●●●●●●●	●●●A●●●●●	●●●●●●●●	●●●C●●●●●	●●●●●●●●
<i>Syrnaticus humiae humiae</i>	●●●●●●●●	●●●●●●●●	●●●A●●●●●	●●●●●●●●	●●●C●●●●●	●●●●●●●●
<i>Syrnaticus mikado</i>	●●●●●●●●	●●●●●●●●	●●●A●●●●●	●●●●●●●●	●●●C●●T●●	T●●●●●●●●
<i>Syrnaticus reevesi</i>	●●●●●●●●	●●●●C●●●●	G●●●●●●●	●●G●●●●●●	●T●●C●●●●	●●●●●●●●
<i>Phasianus colchicus</i>	●●●●●●●●	●●●●C●●●●	●●●T●●●●●	●●●●●●●●	●T●●C●●●●	●●●●●●●●
<i>Catreus wallichii</i>	●●●●●●●●	●●●●C●●●●	G●●●G●●●●	●●●●●●●●	●●●C●●T●●	●●●●●●●●
<i>Chrysolophus pictus</i>	●●●●●●●●	●●●●C●●●●	●●●G●●●●●	T●●●●●●●●	●●●C●●T●●	●●●●●●●●
<i>Chrysolophus p. infuscatus</i>	●●●●●●●●	●●●●C●●●●	●●●G●●●●●	T●●●●●●●●	●●●C●●T●●	●●●●●●●●
<i>Chrysolophus p. obscurus</i>	●●●●●●●●	●●●●C●●●●	●●●G●●●●●	T●●●●●●●●	●●●C●●T●●	●●●●●●●●
<i>Gallus gallus</i>	AACCTCCCAG	CCCCATCCAA	CATCTCTGCT	TGATGAAATF	TCGGCTCCCT	ATTAGCAGTC
<i>Ortalis vetula</i>	G●●●●●●●●	●●●●●●A●●	●●●●●●C●●	●●●●●●●C●	●T●●A●●●●●	CC●●●●A●●
<i>Alectoris chukar</i>	G●T●●T●●TA	●A●●●●A●●	●●●●●●C●C	●●●●●●●C●	●●●●●●●●●	●C●G●●●●A
<i>Alectoris philbyi</i>	G●T●●T●●TA	●A●●●●A●●	●●●●●●C●C	●●●●●●●C●	●●●●●●●●●	●C●●●●●A
<i>Afropavo congensis</i>	G●●●●●●C●	●●●●●●T●●	●●●●●●●●●	●●●●●●G●C●	●T●●●●●●T●	●●●●●●●A
<i>Pavo cristatus</i>	G●●●●●●C●	●T●●●●●T●●	●●●●●●C●●	●●●●●●●C●	●●●●●●●●●	●C●●●●●A
<i>Polyplectron bicalcaratum</i>	G●●●●●●C●	●●●●●●●●●	●●●●●●C●C	●●●●●●G●C●	●●●T●●●●●	CC●●●●●A
<i>Pucrasia macrolopha</i>	G●●●●●●C●	●●●●C●●A●●	●●●●●●●●C	●●●●●●●C●	●●●●●●●●●	●C●●●●●AA
<i>Lophoborus impeyanus</i>	G●●●●●●C●	●●●●●●●●●	●●●●●●A●●	●●●●●●●●●	●●●●●●●●●	CC●●●●●AA
<i>Crossoptilon auritum</i>	G●●●●G●●C●	●●●●●●●●●	●●●●●●C●●	●●●●●●G●C●	●●●●●●●●●	G●●●●●●A
<i>Crossoptilon mantchuricum</i>	G●●●●G●●C●	●●●●●●●●●	●●●●●●C●●	●●●●●●G●C●	●●●●●●●●●	G●●●●●●A
<i>Crossoptilon c. drouyni</i>	G●●●●A●●C●	●●●●●●●●●	●●●●●●C●●	●●●●●●●C●	●●●●●●●●●	G●●●●●●A
<i>Crossoptilon c. crossoptilon</i>	G●●●●A●●C●	●●●●●●●●●	●●●●●●C●●	●●●●●●●C●	●●●●●●●●●	G●●●●●●A
<i>Tragopan caboti</i>	G●●●●●●C●	●●●●●●●●●	●●●●●●C●C	●●●●●●●●●	●T●●●●●●●	●C●●●●●AA
<i>Tragopan satyra</i>	G●●●●●●CA	●●●●●●●●●	●●●●●●C●●	●●●●●●●●●	●T●●●●●●●	●C●●●●●AA
<i>Tragopan temminicki</i>	G●●●●●●C●	●●●●●●●●●	●●●●●●C●C	●●●●●●●●●	●T●●●●●●●	●C●●●●●AA
<i>Lophura edwardsi</i>	G●●●●A●●CA	●●●●●●T●●	●●●●●●C●●	●●●●●●●C●	●●●●●●●●●	●C●G●●●●A
<i>Lophura swinhoii</i>	G●●●●A●●CA	●●●●●●T●●	●●●●●●C●●	●●●●●●●C●	●●●●●●●●●	●C●G●●●●A
<i>Syrnaticus ellioti</i>	G●●●●A●●C●	●●●●●●●●●	●●●T●●●●●	●●●●●●●C●	●●●●●●●●●	CC●●●●●●●
<i>Syrnaticus humiae humiae</i>	G●●●●A●●C●	●●●●●●●●●	●●●T●●●●●	●●●●●●●C●	●●●●●●●●●	CC●●●●●●●
<i>Syrnaticus mikado</i>	G●●●●A●●CA	●T●●●●●●●●	●●●T●●●●●	●●●●●●●C●	●T●●●●●●●	CC●●●●●AA

Appendix Table A. Continued

<i>Syrnaticus reevesi</i>	G●●●●A●●C●	●T●●●●●●●●	T●●●●●●●●C	●●●●●●●●C●	●●●●●●●●●●	CC●●●●●●●G
<i>Phasianus colchicus</i>	G●●●●A●●C●	●●●●C●●●●●	●●●●●●●●●●	●●●●●●●●C●	●●●●T●●●●●	GC●●●●●●●A
<i>Catreus wallichii</i>	G●●●●A●●C●	●●T●●●●●●●	●●●●●●●●●●	●●●●●●●●C●	●●●●T●●●●●	●C●●●●●●●A
<i>Chrysolophus pictus</i>	G●●●●A●●C●	●●●●●●●●●●	T●●●●●●●●C	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●A
<i>Chrysolophus p. infuscatus</i>	G●●●●A●●C●	●●●●●●●●●●	T●●●●●●●●C	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●A
<i>Chrysolophus p. obscurus</i>	G●●●●A●●C●	●●●●●●●●●●	T●●●●●●●●C	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●A
<i>Gallus gallus</i>	TGCCTCATGA	CCCAAATCCT	CACCGGCCTA	CTACTAGCCA	TGCACTACAC	AGCAGACACA
<i>Ortalis vetula</i>	●●●●●T●CA●	●●●●●●●●●●	●●●T●●●●●C	●●●●●●●●●●	●A●●●●●●●●	T●●●●●●●●T
<i>Alectoris chuka</i>	●●T●●TG●C●	●●●●●●●●●●	●●●●●●●●C●	●●C●●●●●●●	●A●●●●●●●●	C●●●●●●●●C
<i>Alectoris philbyi</i>	●●●●●T●●T●	●●●●●●●●●●	●●●●●●●●C●	●●C●●●●●●●	●A●●●●●●●●	C●●●●●●●●C
<i>Afropavo congensis</i>	●●T●●●●CT●	●A●●●●●TA●	●●●T●●●●●G	●●●●●●●●●●	●●●●●●●●●●	C●●●●●●●●●
<i>Pavo cristatus</i>	●●●●●TGCC●	●T●●●●●A●	●●●T●●●●●C	●●●●●●●●●●	●A●●●●●●●●	C●●●●●●●●●
<i>Polyplectron bicalcaratum</i>	●●T●●TGCC●	●●●●●●●●T●	●●●●●G●●C●	●●●●●●●●●●	●A●●●●●●●●	C●●●●●●●●C
<i>Pucrasia macrolopha</i>	●●●●●●●CC●	●●●●●●●●●●	G●●●●●●●C●	●●●●●●●●●●	●A●●●●●●●●	T●●●●●T●●T
<i>Lophophorus impeyanus</i>	●●●●●●●●C●	●●●●●●●●●●	●●●T●●●●●C	●●●●●●●●T●	●A●●●●●●●●	C●●●●●●●●C
<i>Crossoptilon auritum</i>	●●●●●GCT●	●T●●●●●●●●	●●●●●●●●C●	●●●●●G●●●●	●A●●T●●T●●	C●●●●●T●●C
<i>Crossoptilon mantchuricum</i>	●●●●●GCT●	●T●●●●●●●●	●●●●●●●●C●	●●●●●G●●●●	●A●●T●●T●●	C●●●●●T●●T
<i>Crossoptilon c. drouyni</i>	●●●●●GCT●	●T●●●●●●●●	●●●●●●●●C●	●●●●●G●●T●	●A●●T●●T●●	C●●●●●T●●T
<i>Crossoptilon c. crossoptilon</i>	●●●●●GCT●	●T●●●●●●●●	●●●●●●●●C●	●●●●●G●●T●	●A●●T●●T●●	C●●●●●T●●T
<i>Tragopan caboti</i>	●●●●●TGCC●	●T●●●●●●●●	A●●●●●●●C●	●●T●●●●●●●	●A●●●●●●●●	C●●●●●●●●C
<i>Tragopan satyra</i>	●●●●●TGCC●	●T●●●●●●●●	A●●●●●●●C●	●●C●●●●●●●	●A●●●●●●●●	T●●●●●●●●C
<i>Tragopan temminckii</i>	●●●●●TGCC●	●T●●●●●●●●	A●●●●●●●C●	●●T●●●●●●●	●●●●●●●●●●	C●●●●●●●●C
<i>Lophura edwardsi</i>	●●●●●TGCC●	●T●●●●●T●●	●●●●●●●●C●	●●●●●●●●●●	●●●T●●●●●●	T●●●●●T●●T
<i>Lophura swinhoii</i>	●●●●●GCC●	●T●●●●●T●●	●●●●●●●●C●	●●●●●●●●●●	●A●●T●●●●●	CA●●●●T●●T
<i>Syrnaticus ellioti</i>	●●●●●T●●T●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●A●●T●●●●●	T●●●●●●●●C
<i>Syrnaticus bumiae bumiae</i>	●●●●●T●●T●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●A●●T●●●●●	T●●●●●●●●C
<i>Syrnaticus mikado</i>	●●●●●T●CT●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●A●●T●●●●●	T●●●●●●●●C
<i>Syrnaticus reevesi</i>	●●●●●T●CC●	●T●●●●●●●●	●●●●●●●●●●	●●T●●●●●●●	●A●●●●●●●●	T●●●●●●●●C
<i>Phasianus colchicus</i>	●●●●●T●●T●	●T●●●●●●●●	●●●T●●●●●C	●●●T●●●●●●	●A●●T●●●●●	C●●●●●T●●C
<i>Catreus wallichii</i>	●●●●●●●CC●	●T●●●●●●●●	●●●●●T●●C●	●●●●●●●●●●	●A●●●●●●●●	T●●●●●T●●C
<i>Chrysolophus pictus</i>	●●●●●●●●A●	●T●●●●●●●●	●●●●●●●●C●	●●●●●●●●●●	●A●●T●●●●●	C●●●●●T●●T
<i>Chrysolophus p. infuscatus</i>	●●●●●●●●A●	●T●●●●●●●●	●●●●●●●●C●	●●●●●●●●●●	●A●●T●●●●●	C●●●●●T●●T
<i>Chrysolophus p. obscurus</i>	●●●●●●●●A●	●T●●●●●●●●	●●●●●●●●C●	●●●●●●●●●●	●A●●T●●●●●	C●●●●●T●●T
<i>Gallus gallus</i>	TCCCTAGCCT	TCTCCTCCGT	AGCCCACACT	TGCCGGAACG	TACAATACGG	CTGACTCATC
<i>Ortalis vetula</i>	A●●●●T●●T●	●●●●●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●C●●G●●●●●	●●●●●A●●T●
<i>Alectoris chuka</i>	A●●●●C●●●●	●●●●A●A●●●	T●●●●●●●A●	●●T●●●●●T●	●●●G●●●●●●	●●●●●●●●●T
<i>Alectoris philbyi</i>	A●●●●C●●●●	●●●●A●A●●●	T●●●●●●●A●	●●T●A●●●●●	●●●G●●●●●●	●●●●●●●●●T
<i>Pavo cristatus</i>	●●●●●●●●●●	●●●●●●●●A●	●●●●●●●●A●	●●T●A●●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Afropavo congensis</i>	●●●●●●●●●●	●●●●●●●●A●	●●●●●T●●A●	●●●●A●●●●●	●●●●●●●●T●	●●●●●T●●T●
<i>Polyplectron bicalcaratum</i>	●●●●●C●●●●	●●GA●●T●●●	●●●●●●●●C●	●●●●A●●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Pucrasia macrolopha</i>	●●T●●C●●●●	●●●●●●●●●●	G●●●●●●●A●	●●●●A●●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Lophophorus impeyanus</i>	●●●●●C●●●●	●●●●●●●●T●	●●●●●●●●A●	●●●●A●●T●●	●T●●●●●●●●	●●●●●●●●●●
<i>Crossoptilon auritum</i>	●●●●●●●●T●	●●●●●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●●●G●●●●●●	●●●●●●●●●●
<i>Crossoptilon mantchuricum</i>	●●●●●●●●T●	●●●●●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●●●G●●●●●●	●●●●●●●●●●
<i>Crossoptilon c. drouyni</i>	●●●●●●●●T●	●T●T●CT●●●	●●●●●●●●A●	●●●●A●●●●●	●●●G●●●●●●	●●●●●●●●●●
<i>Crossoptilon c. crossoptilon</i>	●●●●●●●●T●	●●●●●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●●●G●●●●●●	●●●●●●●●●●
<i>Tragopan caboti</i>	A●T●●C●●●●	●●●T●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●C●●●●●T●●	●●●●●T●●●●
<i>Tragopan satyra</i>	A●●●●T●●●●	●●●T●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●C●●●●●●●●	T●●●●●T●●●●
<i>Tragopan temminckii</i>	A●T●●C●●●●	●●●T●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●C●●●●●●●●	●●●●●T●●●●
<i>Lophura edwardsi</i>	●●●●T●●●●●	●●●●●●●●T●	●●●●●●●●A●	●T●●C●●●●●	●●●●●●●●●●	●●●●●T●●●●
<i>Lophura swinhoii</i>	●●●●●T●●●●	●●●●●●●●●●	●●●●●●●●●●	●●T●●C●●●●	●●●●●●●●●●	●●●●●T●●●●
<i>Syrnaticus ellioti</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Syrnaticus bumiae bumiae</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Syrnaticus mikado</i>	●●●●●●●●●●	●●●●●●●●T●	●●●●●●●●A●	●●●●A●●●●●	●●●●●●●●●●	T●●●●●●●●●●
<i>Syrnaticus reevesi</i>	●●●●●●●●T●	●●●●●●●●●●	●●●●●●●●G●	●T●●A●●T●●	●C●●●●●●●●	●●●●●T●●●●
<i>Phasianus colchicus</i>	●●●●●●●●●●	●●●T●●●●●●	●●●●●●●●A●	●T●●A●●T●●	●G●●G●●●●●	●●●●●●●●●●
<i>Catreus wallichii</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●A●	●T●●A●●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Chrysolophus pictus</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●●●●●●●●●●	T●●●●●T●●●●
<i>Chrysolophus p. infuscatus</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●●●●●●●●●●	T●●●●●T●●●●
<i>Chrysolophus p. obscurus</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●A●	●●●●A●●●●●	●●●●●●●●●●	T●●●●●T●●●●
<i>Gallus gallus</i>	CGGAATCTCC	ACGCAAACGG	CGCCTCATTC	TTCTTCATCT	GTATCTTCCT	TCACATCGGA
<i>Ortalis vetula</i>	●●C●●C●●A●	●T●●●●●●●●	●●●●●T●●●●	●●●●●●●●●●	●C●●●●A●●●	C●●●●●T●●T●
<i>Alectoris chuka</i>	●●C●●C●●●●	●T●●●●●●●●	●●●●●●●●●●	●●●●●●●●T●	●C●●T●●●●●	C●●●●●●●●●●



Appendix Table A. Continued

<i>Crossoptilon c. crossoptilon</i>	●●●●●●●●	●●●●●●A●	●●●T●●●●●	●●A●C●C●C	●●●●●●A●	A●●●●●●●●
<i>Tragopan caboti</i>	●●●●●●●●	●●●●●●A●	●●●●●●C●A	●●A●●●●●A	●●●●●●A●	A●●●●●●●●
<i>Tragopan satyra</i>	●●●●●●●●	●●●●●●A●	●●●●●●●●A	●●G●C●C●C	●●●●●●A●	A●●●●●●●●
<i>Tragopan temminckii</i>	●●●●●●●●	●●●●●●A●	T●●●●●C●A	●●A●●●●●A	●●●●●●A●	A●●●●●●●●
<i>Lophura edwardsi</i>	●●●●●●●●	●●●●G●A●	●●●●●●C●A	●●A●●●●●C	T●●●●●A●	A●●●●●●●●
<i>Lophura swinboii</i>	●●●●●●●●	●●●●●●A●	●●●●●●C●A	●●A●●●●●C	T●●●●●A●	A●●●●●●●●
<i>Syrnaticus ellioti</i>	●●T●●●●●●	●●●●●●A●	●●●●●●C●A	●●A●●●●●C	T●●●●●A●	A●●●●●●●●
<i>Syrnaticus bumiae bumiae</i>	●●T●●●●●●	●●●●●●A●	●●●●●●C●A	●●A●●●●●C	T●●●●●A●	A●●●●●●●●
<i>Syrnaticus mikado</i>	●●T●●●●●●	●●●●●●A●	●●●●●●C●A	●●G●C●C●C	T●●●●●A●	A●●●●●●●●
<i>Syrnaticus reevesi</i>	●●●●●T●●●	●●T●●●●●A	T●●●●●C●A	●●A●●●●●C	●●●●●●A●	A●●●●●●●●
<i>Phasianus colchicus</i>	●●●●●●●●	●●●●●●A●	●●●●●●C●A	●●A●●●●●C	T●●●●●A●	A●●●●●●●●
<i>Catreus wallichii</i>	●●●●●●●●	●●●●●●A●	●●●●●●C●A	●●A●C●C●C	T●●●●●A●	A●●●●●●●●
<i>Chrysolophus pictus</i>	●●●●●●●●	●●●●●●A●	●●●●●●●●A	●●G●C●C●C	●●●●●●A●	A●●●●●●●●
<i>Chrysolophus p. infuscatus</i>	●●●●●●●●	●●●●●●A●	●●●●●●●●A	●●G●C●C●C	●●●●●●A●	A●●●●●●●●
<i>Chrysolophus p. obscurus</i>	●●●●●●●●	●●●●●●A●	●●●●●●●●A	●●G●C●C●C	●●●●●●A●	A●●●●●●●●
<i>Gallus gallus</i>	TTCTGAGGGG	CCACCGTTAT	CACAAACCTA	TTCTCAGCAA	TTCCCTACAT	TGGACACACC
<i>Ortalis vetula</i>	●●●●●●●●	●●●●●●C●	T●●C●T●●●	●●●●●●T●	●●C●A●●●●	C●●●●●A●●
<i>Alectoris chuka</i>	●●●●●●●●	●●T●●●●●A	●●●●●●T●●	●●●●●●C●	●●C●●●●●●	C●●●●●A●●
<i>Alectoris phillyi</i>	●●●●●●●●	●●T●●●●●C	●●●●●●T●●	●●●●●●CG	●●C●●●●●●	C●●●●●A●●
<i>Afropavo congensis</i>	●●●●●●●●	●A●T●●C●	●●●●●●●●	●A●●●●●●	●●C●●●●●T	●●T●●A●●
<i>Pavo cristatus</i>	●●●●●●●●	●A●T●●●●	●●●●●●TT●	●●●●●●●●	●●C●T●●T●	C●●●●●A●●
<i>Polyplectron bicalcaratum</i>	●●●●●●●●	●●●●●●C●	●●●C●●●●●	●●●●●●●●	●●C●●●●●●	C●●●●●A●●
<i>Pucrasia macrolopha</i>	●●●●●●●●	●●T●●●●●C	●●●●●●●●	●●●●●●●●	●●C●T●●●●	●●●●●A●T
<i>Lophoborus impeyanus</i>	●●●●●●●A	●●●●●●C●	●●●●●●T●	●●●●●●●●	●●C●T●●●●	C●●T●●A●●
<i>Crossoptilon auritum</i>	●●T●●●●●●	●●T●●●●●C	●●●●●●T●	●●●●●●●●	●●C●T●●●●	C●●●●●A●●
<i>Crossoptilon mantchuricum</i>	●●T●●●●●●	●●T●●●●●C	●●●●●●T●	●●●●●●●●	●●C●T●●●●	C●●●●●A●●
<i>Crossoptilon c. crossoptilon</i>	●●T●●●●●●	GT●●●●●C	●●●●●●T●	●●●●●●●●	●●C●T●●●●	●●●●●A●●
<i>Crossoptilon c. drouyni</i>	●●T●●●●●●	●●T●●●●●C	●●●●●●T●	●●●●●●●●	●●C●T●●●●	●●●●●A●●
<i>Tragopan caboti</i>	●●T●●●●●A	●●T●●●●●C	●●●●●●TT●	●●T●●●●●●	●●C●A●●●●	●●C●A●●T
<i>Tragopan satyra</i>	●●T●●●●●A	●●T●●●●●C	●●●●●●●●	●●●●●●●●	●●C●T●●●●	C●●●●●G●●
<i>Tragopan temminckii</i>	●●TG●●●●●	●●T●●●●●C	●●●●●●TT●	●●●●●●●●	●●C●A●●●●	●●C●AG●●
<i>Lophura edwardsi</i>	●●T●●●●●A	●●T●●●●●C	●●●●●●●●	●●●●●●●●	●●C●●●●●●	C●●●●●A●●
<i>Lophura swinboii</i>	●●T●●●●●A	●●T●●●●●C	●●●●●●●●	●●●●●●●●	●●C●●●●●●	C●●●●●A●●
<i>Syrnaticus ellioti</i>	●●●●●●●A	●●●●●●●●	●●●●●●T●	●●●●●●●●	●●C●●●●●●	C●●●●●A●●
<i>Syrnaticus bumiae bumiae</i>	●●●●●●●A	●●●●●●●●	●●●●●●T●	●●●●●●●●	●●C●●●●●●	C●●●●●A●●
<i>Syrnaticus mikado</i>	●●●●●●●A	●●●●●●●●	●●●●●●TT●	●●●●●●●●	●●C●●●●●●	C●●●●●A●●
<i>Syrnaticus reevesi</i>	●●T●●●●●●	●A●●●●●C	●●●●●●TT●	●●●●●●●●	●●C●●●●●●	C●●●●●A●●
<i>Phasianus colchicus</i>	●●T●●●●●A	●●T●●●●●C	●●●●●●●●	●●●●●●●●	●●C●●●●●●	●●●●●A●●
<i>Catreus wallichii</i>	●●T●●●●●●	●●T●●T●C●	●●●●●●T●	●●●●●●●●	●●C●T●●●●	C●●●●●G●●
<i>Chrysolophus pictus</i>	●●T●●●●●●	●●T●●●●●C	●●●●●●●●	●●●●●●●●	●●C●T●●●●	C●●●●●G●●
<i>Chrysolophus p. infuscatus</i>	●●T●●●●●A	●●T●●●●●C	●●●●●●●●	●●●●●●●●	●●C●T●●●●	C●●●●●G●●
<i>Chrysolophus p. obscurus</i>	●●T●●●●●A	●●T●●●●●C	●●●●●●●●	●●●●●●●●	●●C●T●●●●	C●●●●●G●●
<i>Gallus gallus</i>	CTAGTAGAGT	GAGCCTGAGG	GGGATTTTCA	GTCGACAACC	CAACCCTTAC	CCGATTCTTC
<i>Ortalis vetula</i>	●●●●●●●A	●G●●T●●●●	●●●●●●C●	●●T●●●●●●	●●●●●●A●	A●●●●●●●●
<i>Alectoris chuka</i>	●●●●●●●●	●●●●C●●●●	●●●G●●C●●	●●●●●●●●	●●●●●●●●	●●●●●T●●●
<i>Alectoris phillyi</i>	●●●●●●●A	●●●●C●●●●	●●●G●●C●●	●●●●●●●●	●●●●●●●●	●●●●●●●●
<i>Afropavo congensis</i>	●●●●●●●A	●G●●C●●●●	A●●●●●C●●	●●T●●●●●●	●●●●●●C●	●●●●●●●●
<i>Pavo cristatus</i>	●●●●●●●A	●●●●C●●●●	A●●●●●C●●	●●●●●●●●	●●●●●●●●	●●●●●●●●
<i>Polyplectron bicalcaratum</i>	●●●●G●●A	●●●●●●G●	●●●●●●C●	●●T●●●●●●	●●●●T●●●	●●●●●●●●
<i>Pucrasia macrolopha</i>	●●●●●●●●	●●●●●●●●	A●●●●●C●	●●●●●●●●	●●●●●●C●	●●●●●●●●
<i>Lophoborus impeyanus</i>	●●●●●●●A	●●●●●●●●	●●●C●●●●	●●●●●●●●	●●●●●●●●	●●●●●●●●
<i>Crossoptilon auritum</i>	●●●●G●●●	●G●●●●●●	A●●●●●C●	●●T●●●●●●	●●●●●●C●	●●●●●●●●
<i>Crossoptilon mantchuricum</i>	●●●●G●●●	●G●●●●●●	A●●●●●C●	●●T●●●●●●	●●●●●●C●	●●●●●●●●
<i>Crossoptilon c. drouyni</i>	●●●●C●●●	●●●●●●●●	●●●●●●C●	●●T●●●●●●	●●●●●●C●	●●●●●●●●
<i>Crossoptilon c. crossoptilon</i>	●●●●C●●●	●●●●●●●●	●●●●●●C●	●●T●●●●●●	●●●●●●C●	●●●●●●●●
<i>Tragopan caboti</i>	●●●●●●●A	●G●●●●●●	●●●C●●●●	●●T●●●●T●	●●●●●●C●	●●●●●●●T
<i>Tragopan satyra</i>	●●●●●●●A	●●●●●●G●	A●●●●●C●	●●T●●●●●●	●●●●●●C●	●●●●●●●●
<i>Tragopan temminckii</i>	●●●●●●●A	●●●●T●●●	●●●C●●●●	●●T●●●●T●	●●●●●●●●	●●●●●●●T
<i>Lophura edwardsi</i>	●●●●●●●A	●●●●T●●●	T●●●●G●●	●●T●●●●●●	●●●●●●●●	●●●●●●●T
<i>Lophura swinboii</i>	●●●●●●●A	●●●●T●●●	T●●●●●●●	●●T●●●●●●	●●●●●●●●	●●●●●●●●
<i>Syrnaticus ellioti</i>	●●●●●●●A	●●●●●●●●	●●●●●●C●	●●T●●T●T●	●●C●●●●C●	●●●●●●●●
<i>Syrnaticus bumiae bumiae</i>	●●●●●●●A	●●●●●●●●	●●●●●●C●	●●T●●T●T●	●●C●●●●C●	●●●●●●●●
<i>Syrnaticus mikado</i>	●●●●●●●●	●●●●●●G●	●●●●●●C●	●●T●●T●T●	●●C●●●●C●	●●●●●●●●

**Appendix Table A.** Continued

<i>Syrnaticus reevesi</i>	●●●●●●●●	●G●●●●●●●●	A●●●●●C●●●	●●T●●●●●●●	●●●●T●●C●●	●●●●●●●●●●
<i>Phasianus colchicus</i>	T●G●●●●●A●	●GA●●●●●●●	●●●●●●C●●●	●●T●●●●●●●	●●●●●●C●●●	●●●●●●●●●●
<i>Catreus wallichii</i>	●●●●●●●●A●	●●●●●●●●●●	A●●●●●C●●●	●●T●●●●●T●	●●●●●●C●●●	●●●●●●●●●●
<i>Chrysolophus pictus</i>	●●●●●●●●A●	●●●●●●●●G●	A●●●●●C●●●	●●T●●●●●●●	●●●●●●C●●●	●●●●●●●●●●
<i>Chrysolophus p. infuscatus</i>	●●●●●●●●A●	●●●●●●●●G●	A●●●●●C●●●	●●T●●●●●●●	●●●●●●C●●●	●●●●●●●●●●
<i>Chrysolophus p. obscurus</i>	●●●●●●●●A●	●●●●●●●●G●	A●●●●●C●●●	●●T●●●●●●●	●●●●●●C●●●	●●●●●●●●●●
<i>Gallus gallus</i>	GCTTTACT	TCCTCCTCCC	CTTTGCAATC	GCAGGTATTA	CTATCATCCA	CCTCACCTTC
<i>Ortalis vetula</i>	●●●●●●●●	●TT●A●●A●●	T●●●●●●●●	●●●●●●C●●●	●C●●A●●●●●	●●●●●●●●●●
<i>Alectoris chuka</i>	●●CC●C●●●●	●●●●●●●●●●	●●●C●T●●●●	●●●●●A●●C●	●C●●●●●●●●	●●●●●A●●●●
<i>Alectoris phillyi</i>	●●CC●C●●●●	●●●●●●●●●●	●●●CCT●●●●	●●●●●A●●C●	●C●●●●T●●●	●●●●●A●●●●
<i>Afropavo congensis</i>	●●CC●●●●●●	●T●●T●●●●●	●●●●CT●●T●	●●G●●A●●●●	●A●●T●●●●●	●●●●●A●●●●
<i>Pavo cristatus</i>	●●CC●●●●●●	●T●●●●●●●●	●●●●●T●●●●	●●●●●A●●●●	●A●●T●●●●●	●●●●●A●●●●
<i>Polyplectron bicalcaratum</i>	●●CC●●●●●●	●●●●T●●●●●	●●●●T●●●●●	●●●●●A●●C●	●●●●●●T●●●	●●●●●A●●●●
<i>Pucrasia macrolopha</i>	●●CC●●●●●●	●●●●A●●●●●	●●●C●T●●●●	●●●●●A●●C●	●●●●●●●●●●	●●●A●●A●●●
<i>Lophoborus impeyanus</i>	●●●●●●●●●●	●●●●●●●●●●	●●●CCT●●T●	●●●●●A●●C●	●C●●T●●●●●	●●●TGTA●●●
<i>Crossoptilon auritum</i>	●●CC●●●●●●	●●●●●●●●●●	●●●C●T●●T●	●●●●●A●●●●	●●●●●C●●●●	●●●●●TA●●●●
<i>Crossoptilon mantchuricum</i>	●●CC●●●●●●	●●●●●●●●●●	●●●C●T●●T●	●●●●●A●●●●	●●●●●C●●●●	●●●●●TA●●●●
<i>Crossoptilon c. drouyni</i>	●●CC●●●●●●	●●●●●●●●●●	●●●C●T●●T●	●●●●●A●●●●	●●G●●●C●●●	●●●●●TA●●●●
<i>Crossoptilon c. crossoptilon</i>	●●CC●●●●●●	●●●●●●●●●●	●●●C●T●●T●	●●●●●A●●●●	●●G●●●C●●●	●●●●●TA●●●●
<i>Tragopan caboti</i>	●●CC●●●●●●	●●●●●●●●●●	A●●●●T●●●●	●●●●●A●●C●	●C●●●●●●●●	●●●●●T●●●●
<i>Tragopan satyra</i>	●●CC●●●●●●	●●●●●●●T●●	●●●CAT●●T●	●●●●●A●●●●	●C●●●●C●●●	●●●●●TA●●●●
<i>Tragopan temminicki</i>	●●CC●●●●●●	●●●●●●●●●●	A●●●●T●●●●	●●●●●A●●●●	●C●●●●●●●●	●●●●●T●●●●
<i>Lophura edwardsi</i>	●●CC●●●●●●	●●●●●●●●●●	●●●C●T●●T●	●●●●●A●●C●	●C●●●●T●●●	●●●●●CTA●●●
<i>Lophura swinhoii</i>	●●CC●●●●●●	●●●●●●●●●●	●●●C●T●●T●	●●●●●A●●C●	●C●●●●T●●●	●●●●●CA●●●●
<i>Syrnaticus ellioti</i>	●●CC●C●●●●	●T●●●●G●●●	●●●C●T●●T●	A●●●●A●●C●	●C●●●●C●●●	T●●●●TA●●●●
<i>Syrnaticus humiae humiae</i>	●●CC●C●●●●	●T●●●●G●●●	●●●C●T●●T●	A●●●●A●●C●	●C●●●●CT●●	●●●●●TA●●●●
<i>Syrnaticus mikado</i>	●●CC●C●●●●	●T●●●●A●●●	●●●C●T●●T●	A●●●●A●●●●	●C●●●●C●●●	●●●●●TA●●●●
<i>Syrnaticus reevesi</i>	●●CC●T●●●●	●T●●●●A●●●	●●●C●T●●●●	A●●●●A●●C●	●C●●●●CA●●	T●●T●TG●●●
<i>Phasianus colchicus</i>	●●CC●●●●●●	●T●●●●T●●●	●●●C●T●●●●	A●●●●C●●C●	●C●●●●CT●●	●●●●●TA●●●●
<i>Catreus wallichii</i>	●●CC●G●●●●	●●●●●●●T●●	●●●C●T●●T●	●●●●●A●●C●	●C●●●●C●●●	T●●●●TA●●●●
<i>Chrysolophus pictus</i>	●●CC●●●●●●	●●●●●●T●●●	●●●CAT●●T●	●●●●●A●●●●	●C●●●●C●●●	T●●●●TA●●T●
<i>Chrysolophus p. infuscatus</i>	●●CC●●●●●●	●●●●●●T●●●	●●●CAT●●T●	●●●●●A●●●●	●C●●●●C●●●	T●●●●TA●●T●
<i>Chrysolophus p. obscurus</i>	●●CC●●●●●●	●●●●●●T●●●	●●●CAT●●T●	●●●●●A●●●●	●C●●●●C●●●	T●●●●TA●●T●
<i>Gallus gallus</i>	CTACACGAAT	CAGGCTCAAA	CAACCCCTA	GGCATCTCAT	CCGACTCTGA	CAAAATTCCA
<i>Ortalis vetula</i>	●●T●●●●●●●	●T●●●●●●●●	●●●●●●●●●●	●●GC●●A●●●	●●●●T●●GC●	T●●●●●●●T●
<i>Alectoris chuka</i>	●●●●●●●●●●	●C●●●●●●●●	●●●T●●A●●●	●●●●●T●●●●	●AA●●●●C●●	●●●●●C●●●●
<i>Alectoris phillyi</i>	●●C●●●●G●	●C●●●●●●●●	●●●T●●A●●●	●●●●●●●●●●	●AA●●●●C●●	●●●●●C●●●●
<i>Afropavo congensis</i>	●●T●●T●●●●	●●●●●●●●●●	●●●●●A●●G●	●●●●●●●●●●	●●A●T●●A●●	T●●●●●C●●●●
<i>Pavo cristatus</i>	●●CC●●●●●●	●●●●●●●●●●	●●●T●●A●●●	●●●●●●●●●●	●●A●●●●A●●	●●●●●●●●●●
<i>Polyplectron bicalcaratum</i>	●●T●●●●●●●	●●●●T●●●●●	●●●●●A●●●●	●●●●●T●●●●	●●A●●●●●●●	●●●●●C●●●●
<i>Pucrasia macrolopha</i>	T●●●●●●●●●	●●●●●●●●●●	●●●●●A●●●●	●●●●●●●●●●	●●A●●●●●●●	●●●●●●●●T●
<i>Lophoborus impeyanus</i>	T●●●●T●●●●	●●●●●●●●●●	●●●T●●A●●●	●●●●●●●●●●	●TA●●●G●●●	●●●●●C●●●●
<i>Crossoptilon auritum</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●A●●●●	●●●●●●●●●●	●TA●T●●C●●	●●●●●C●●●●
<i>Crossoptilon mantchuricum</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●A●●●●	●●●●●●●●●●	●TA●T●●C●●	●●●●●C●●●●
<i>Crossoptilon c. drouyni</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●A●●●●	●●●●●●●●●●	●TA●T●●C●●	●●●●●C●●●●
<i>Crossoptilon c. crossoptilon</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●A●●●●	●●●●●●●●●●	●TA●T●●C●●	●●●●●C●●●●
<i>Tragopan caboti</i>	●●●●●T●●●●	●●●●●●T●●●	●●●●●T●●G●	●●●●●●●●●●	●TA●T●●●●●	●●●●●C●●●●
<i>Tragopan satyra</i>	●●●●●T●●●●	●●●●●●●●●●	●●●●●T●●●●	●●●●●●●●●●	●TA●●●●●●●	●●●●●C●●●●
<i>Tragopan temminicki</i>	●●●●●T●●●●	●●●●●●●●●●	●●●●●T●●●●	●●●●●●●●●●	●TA●●●●●●●	●●●●●C●●●●
<i>Lophura edwardsi</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●A●●●●	●●●●●●●●●●	●TA●●●●C●●	●●●●●C●●●●
<i>Lophura swinhoii</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●A●●●●	●●●●●●●●●●	●TA●●●●C●●	●●●●●C●●●●
<i>Syrnaticus ellioti</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●TA●●●●●●●	●●●●●C●●●●
<i>Syrnaticus humiae humiae</i>	●●●●●●●●●●	●●●●●●●●●●	●●●T●●●●●●	●●●●●●●●●●	●TA●●●●●●●	●●●●●C●●●●
<i>Syrnaticus mikado</i>	●●G●●●●●●●	●●●●●●●●●●	●●●T●●T●●●	●●●●●●●●●●	●TA●●●●●●●	●●●●●C●●●●
<i>Syrnaticus reevesi</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●A●●●●	●●●●●T●●●●	●TA●●●●●●●	●●●●●C●●C●
<i>Phasianus colchicus</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●A●●●●	●●●●●●●●●●	●A●●●●C●●	●●●●●C●●●●
<i>Catreus wallichii</i>	●●●●●T●●●●	●●●●●●●●●●	T●●●●●●●●●	●●●●●●●●●●	●TA●●●●C●●	●●●●●C●●●●
<i>Chrysolophus pictus</i>	●●●●●●●G●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●TA●●●●C●●	●●●●●C●●●●
<i>Chrysolophus p. infuscatus</i>	●●●●●●●G●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●TA●●●●●●●	●●●●●C●●●●
<i>Chrysolophus p. obscurus</i>	●●●●●●●G●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●T●GTA●●●●	●●●●●C●●●●
<i>Gallus gallus</i>	TTTCACCCAT	ACTACTCCTT	CAAAGACATT	CTGGGCTTAA	CTCTCATACT	CACCCCATTC
<i>Ortalis vetula</i>	●●C●●●●●C●	●●●T●●●●C●	A●●●●●●●●●	●●●●●●●●TT	●A●●●●●●T●	T●T●●●●CC●●
<i>Alectoris chuka</i>	●●●●●●●●●●	●●●●●●●A●●	●●●●●●●●●●	T●A●●●●C●●●	●A●●A●●●T●	T●TT●●●●●●

Appendix Table A. Continued

<i>Alectoris pibillyi</i>	●●●●●●●●	●●●●●●A●	●●●●●●●●	T●A●●●C●●G	●A●●A●●●T●	T●TT●●●T●●
<i>Afropavo congensis</i>	●●C●●●●●G●	●●●●●●●●C●	●●●●●●T●●●	●●A●●●●●●G	●A●●●●●G●●	●●TT●●●T●●
<i>Pavo cristatus</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●T●●●	●●A●●●●●●●	●A●●T●●●T●	T●T●●●●T●●
<i>Polyplectron bicalcaratum</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●T●●●	●●A●●●C●●G	●A●●●●●●T●	T●T●●●●T●●
<i>Pucrasia macrolopha</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●●●●●	T●A●●●C●T●	●A●●●●●●●●	●●T●●●CC●●
<i>Lophoborbus impeyanus</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●●●●●	●●T●●●C●●●	●A●●●●●G●●	●●T●●●CT●●
<i>Crossoptilon auritum</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●●●●●	●●A●●●C●●G	●A●●T●●●T●	●●●●●●T●●
<i>Crossoptilon mantchuricum</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●●●●●	●●A●●●C●●G	●A●●T●●●T●	●●●●●●T●●
<i>Crossoptilon c. drouyni</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●GG●●●●	●●A●●●C●●G	●●A●T●●●T●	●●●●●●T●●
<i>Crossoptilon c. crossoptilon</i>	●●C●●●●●C●	●●●●●●●●C●	●●●●●●●●●●	●●A●●●C●●G	●A●●T●●●●●	●●●●●●T●●
<i>Tragopan caboti</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●T●●●	●●A●●●C●●G	●A●●●●●●●●	●●●T●●TC●●
<i>Tragopan satyra</i>	●●C●●●●●G●	●●●●●●●●C●	●●●●●●T●●●	●●A●●●C●●●	●A●●●●●●●●	●●●T●●CC●●
<i>Tragopan temminicki</i>	●●C●●●●●G●	●●●●●●●●C●	●●●●●●T●●●	●●A●●●C●●●	●A●●●●●●●●	●●●T●●CC●●
<i>Lophura edwardsi</i>	●●C●●●●●●●	●●●●●●T●●●	●●●●●●●●●●	T●A●●●C●●G	●A●●T●●●T●	●●●●●●T●●
<i>Lophura swinboii</i>	●●C●●●●●●●	●●●●●●●●T●	●●●●●●T●●●	T●A●●●●●●G	●A●●●●●●●●	T●●●●●●T●●
<i>Symaticus ellioti</i>	●●●●●●●●●●	●●●●T●●●C●	●●●●●●●●●●	●●A●●●C●●G	●A●●●●●●●●	●●●●●●T●●
<i>Symaticus bumiae bumiae</i>	●●●●●●●●●●	●●●●T●●●C●	●●●●●●●●●●	●●A●●●C●●G	●A●●●●●●●●	●●●●●●T●●
<i>Symaticus mikado</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●●●●●	●●A●●●C●●G	●A●●●●●●●●	●●●●●●T●●
<i>Symaticus reevesi</i>	●●●●●●●●●●	●●●●●●TC●●	●●●●●●T●●●	●●A●●●C●●G	●A●●T●●●●●	●●●●●●T●●
<i>Phasianus colchicus</i>	●●C●●●●●T●	●●●●●●●●C●	●●●●●●●●●●	●●A●●●●●●G	●A●●G●●●●●	●●●●●●T●●
<i>Catreus wallichii</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●T●●●	●●A●●●C●●G	●A●●T●●●T●	●●●●●●T●●
<i>Chrysolophus pictus</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●T●●●	●●A●●●C●●G	●A●●T●●●●●	T●●●●●T●T●
<i>Chrysolophus p. infuscatus</i>	●●C●●●●●●●	●●●●T●●●C●	●●●●●●T●●●	●●A●●●C●●G	●A●●T●●●●●	T●●●●●T●T●
<i>Chrysolophus p. obscurus</i>	●●C●●●●●●●	●●●●●●●●C●	●●●●●●T●●●	●●A●●●C●●G	●A●●T●●●T●	●●●●●●T●●
<i>Gallus gallus</i>	CTAACACTAG	CCCTATTCTC	CCCCAACCTC	CTAGGAGACC	CAGAAAACCT	CACCCCAGCA
<i>Ortalis vetula</i>	●●●●●●●●●●C●	●●T●●●C●●●CA	●●●●T●●●●●	●●●●●●●●●●	●●●●●●●●T●●	T●●●●●●●●●
<i>Alectoris chuka</i>	●●●●●●●●●●	●●T●●●●●●●	●●●●T●●●T●	●●●●●●●●T●	●●●●●●●●●●	T●●●●●●●●C
<i>Alectoris pibillyi</i>	●●●●●●●●●●	●●T●●●●●●●	T●●T●●●T●●	●●●●●●T●●T●	●●●●●●●●●●	T●●●●●●●●C
<i>Afropavo congensis</i>	●●G●●●●●●●	●●●●●●C●●●	●●●●●●●●●●	T●●●●T●●T●	●●●●●●●●●●	●●●●●●●●●●
<i>Pavo cristatus</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	A●●●●●T●●●	●●●●●●C●●●	●●●●●●●●●●
<i>Polyplectron bicalcaratum</i>	●●C●●●●●●●	●●T●●●●T●●	●●●●●●●●●●	●●●●●●T●●●	●●●●●●T●●●	T●●●●●●●●●
<i>Pucrasia macrolopha</i>	●●C●●●●●●●	●●●●●●●●●●	A●●T●●●●●●	T●●●●T●●●●	●●●●●●●●●●	T●●●●●●●●●
<i>Lophoborbus impeyanus</i>	●●C●●●●●●●	●●●●●●●●●●	A●●T●●●●●●	●●●●●C●●T●	●●●●●●●●●●	T●●●●●●●●●
<i>Crossoptilon auritum</i>	●●●●T●●●●●	●●●●●●●●●●	A●●T●●●●T●	●●G●●C●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Crossoptilon mantchuricum</i>	●●●●T●●●●●	●●●●●●●●●●	A●●T●●●●T●	●●G●●C●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Crossoptilon c. drouyni</i>	●●●●T●●●●●	●●●●●●●●●●	A●●T●●●●T●	●●G●●C●●●●	●●●●●●●●●●	T●●●●●●●●●
<i>Crossoptilon c. crossoptilon</i>	●●●●T●●●●●	●●●●●●●●●●	A●●T●●●●T●	●●G●●C●●●●	●●●●G●●●●●	●●●●●●●●●●
<i>Tragopan caboti</i>	●●C●●●●●●●	●●T●●●●T●●	A●●A●●●●●A	●●●●●T●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Tragopan satyra</i>	●●C●●●●●●●	●●T●●●●T●●	A●●A●●●●●A	●●●●●T●●T●	●●●●●●●●●●	●●●●●●●●●●
<i>Tragopan temminicki</i>	●●C●●●●●●●	●●T●●●●T●●	A●●A●●●●●A	●●●●●T●●T●	●●●●●●●●●●	●●●●●●●●●●
<i>Lophura edwardsi</i>	●●●●●●●●●●	●●●●●●●●●●	A●●A●●●●●T	●●●●●T●●T●	●●●●●●T●●●	●●●●●●●●●●
<i>Lophura swinboii</i>	●●●●●●●●●●	●●●●●●●●●●	A●●A●●●●●T	●●●●●C●●T●	●●●●●●T●●●	●●●●●●●●●●
<i>Symaticus ellioti</i>	●●C●●●●●●●	●●●●●●●●●●	G●●A●●●●●A	●●●●●T●●●●	●●●●G●●T●●	●●●●●●●●●●
<i>Symaticus bumiae bumiae</i>	●●C●●●●●●●	●●●●●●●●●●	G●●A●●●●●A	●●●●●T●●●●	●●●●G●●T●●	●●●●●●●●●●
<i>Symaticus mikado</i>	●●C●●●●●A●	●●●●●●●●●●	A●●A●●●●●T	●●●●●T●●●●	●●●●●●T●●●	●●●●●●●●●●
<i>Symaticus reevesi</i>	●●C●●●●●●●	●●●●●●●●●●	A●●T●●●●G	●●●●●C●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Phasianus colchicus</i>	●●●●●●T●●●	●●●●●●●●●●	A●●A●●●●●T	●●●●●C●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Catreus wallichii</i>	●●●●●●●●●●	●●●●●●●●●●	A●●A●●T●●T	●●G●●C●●●●	●●●●●●●●●●	●●●●●●●●●●
<i>Chrysolophus pictus</i>	●●C●●●●●C●	●●●●●●●●●●	●●●●A●●●●T	●●●●●C●●●●	●●●●●●●●●●	T●●●●●●●●●
<i>Chrysolophus p. infuscatus</i>	●●C●●●●●C●	●●●●●●●●●●	●●●●A●●●●T	●●●●●C●●●●	●●●●●●●●●●	T●●●●●●●●●
<i>Chrysolophus p. obscurus</i>	●●C●●●●A●	●●T●●●●A●	A●●A●●●T●A	●●●●●●●●●●	●●●●●●●●●●	A●●●●●●●●●
<i>Gallus gallus</i>	AACCCACTAG	TAACCCCCCC	ACATATCAAA	CCAGAATGAT	ATTTTCTATT	CGCCTATGCC
<i>Ortalis vetula</i>	●●G●●C●●●C●	●●T●●●●A●●	●●●C●●●●●●	●●T●●●●●●●	●●●●C●●●●●	●●●●●C●●●T
<i>Alectoris chuka</i>	●●●●●C●●●●	●●●●●●●●●●	T●●C●●T●●●	●●●●●●●●●●	●●C●●C●●●●	●●●●●C●●●●
<i>Alectoris pibillyi</i>	●●●●●C●●●●	●●●●●●●●●●	T●●C●●T●●●	●●●●●●●●●●	●●C●●C●●●●	T●●●●C●●●●
<i>Afropavo congensis</i>	●●●●●T●●●●	●●●●●T●●●●	●●●C●●T●●●	●●●●●●●●G●	●●●●CT●●●●	T●●●●●●●●●
<i>Pavo cristatus</i>	●●T●●C●●●●	●●●●●●●●●●	●●●C●●T●●●	●●●●●●●●●●	●●C●●CT●●●	T●●●●●C●●●
<i>Polyplectron bicalcaratum</i>	●●T●●●●●●●	●●G●●G●●●●●	●●●C●●●●●G	●●●●●●●●●●	●●C●●C●●●●	T●●●●●C●●●
<i>Pucrasia macrolopha</i>	●●●●●●●●●●	●●●●●●●●●●	T●●C●●T●●●	●●●●●●●●G●	●●●●●C●●●●	●●●●●C●●●●
<i>Lophoborbus impeyanus</i>	●●●●●●●●●●	●●●●●●●●●●	C●●●●T●●●●	●●●●●●●●●●	●●●●●C●●●●	T●●●●●C●●●
<i>Crossoptilon auritum</i>	●●●●●C●●●●	●●●●●●A●●●	T●●C●●T●●●	●●●●●●●●●●	●●C●●C●●●●	T●●●●●●●T
<i>Crossoptilon mantchuricum</i>	●●●●●●●●●●	●●●●●●A●●●	T●●C●●T●●●	●●●●●●●●●●	●●C●●C●●●●	T●●●●●●●T
<i>Crossoptilon c. drouyni</i>	●●●●●●●●●●	●●●●●●A●●●	CT●C●●T●●●	●●●●●●●●●●	●●C●●C●●●●	T●●●●●●●T

**Appendix Table A.** Continued

<i>Crossoptilon c. crossoptilon</i>	●●●●●T●●●	●●●●●●●●●	T●●C●●T●●●	●●●●●●●●●	●C●●C●●●●●	T●●●●●●●●T
<i>Tragopan caboti</i>	●●●●●●●G●	●●●●T●●T●	C●●●●●●●G	●●●●●●●G●	●●●●C●●G●	●●●TA●●●●●
<i>Tragopan satyra</i>	●●●●●●●●●	●●●●T●●T●	C●●●●●●●●	●●●●●●●●●	●●●●●●●G●	●●●T●●●●●
<i>Tragopan temminicki</i>	●●●●●●●●●	●●●●T●●T●	C●●●●●●●●	●●●●●●●●●	●●●●●●●G●	●●●●●●●●●
<i>Lophura edwardsi</i>	●●●●●●●●●	●●●●●●●T●	C●●C●●T●●●	●●●●●●●G●	●●●●C●●●●	T●●T●●C●●●
<i>Lophura swinboii</i>	●●●●●●●●●	●●●●●●●T●	C●●C●●T●●●	●●●●●●●G●	●●●●C●●●●	T●●T●●C●●●
<i>Syrnaticus ellioti</i>	●●●●●●●●●	●●●●●●●●●	T●●C●●●●●G	●●●●●●●●●	●●●●C●●●●	T●●●●●C●●●
<i>Syrnaticus humiae humiae</i>	●●●●●●●●●	●●●●●●●T●	T●●C●●●●●G	●●●●●●●●●	●●●●C●●●●	T●●●●●C●●●
<i>Syrnaticus mikado</i>	●●●●●●●T●●	●●●●●●●●●	T●●C●●●●●	●●●●●●●●●	●●●●C●●●●	●●●●●●●C●●
<i>Syrnaticus reevesi</i>	●●T●●●T●●●	●●●●●●●T●	T●●C●●T●●●	●●●●●●●●●	●C●●C●●●●	T●●●●●C●●●
<i>Phasianus colchicus</i>	●●●●●●●●●	●●●●●●●T●	T●●●●●T●●	●●●●●●●●●	●C●●CT●●●●	●●●●●●●C●●
<i>Catreus wallichii</i>	●●●●●●●●●	●●●●●●●A●	●●●C●●T●●●	●●●●●●●G●	●C●●CT●●●●	T●●●●●C●●T
<i>Chrysolophus pictus</i>	●●●●●●●●●	●●●●T●●●●	C●●C●●●●●	●●●●●●●●●	●C●●C●●●●	T●●●●●C●●●
<i>Chrysolophus p. infuscatus</i>	●●●●●●●T●●	●●●●T●●●●	C●●C●●●●●	●●●●●●●●●	●C●●C●●●●	T●●●●●C●●●
<i>Chrysolophus p. obscurus</i>	●●●●●●●T●●	●●●●T●●●●	CA●C●●●●●	●●●●●●●●●	●C●●C●●●●	T●●●●●C●●●
<i>Gallus gallus</i>	ATCCTACGCT	CCATCCCCAA	CAAACCTTGG	GGTGTACTAG	CCCTAGCAGC	CTCAGTCCTC
<i>Ortalis vetula</i>	●●●●●●●●●	●T●●●●●●●	●●●●●●C●●	●●A●●C●●C●	●A●●●●●●●	T●●●●●A●●A
<i>Alectoris chukae</i>	●●●●●●●●●	●A●●●●●A●	●●●●●●C●●	●●C●●●●●T●	●●●●●●●●●	●●●●●●A●●
<i>Alectoris philbyi</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●C●●	●●C●●●●●T●	●●●●●●●●●	●●●●●●A●●
<i>Afropavo congensis</i>	●●●●●T●●●	●A●●●●●A●	●●●●●●A●●	●●●●●●●●●	●●●●●●●●●	●●●●●●A●T
<i>Pavo cristatus</i>	●●●●●C●●T●	●G●●●●●●●	●●●●●●A●●	●●C●●●●●●	●●●●●●●●●	●●●●●●AT●●
<i>Polyplectron bicalcaratum</i>	●●●●●●●●●	●A●●●●●A●	●●●●●●C●●	●●●●●●●G●	●T●●●●●●●	A●●●●●A●●
<i>Pucrasia macrolopha</i>	●●T●●C●●●●	●A●●●●●A●	●●●●●●C●●	●●●●●●●●●	●●●●●●●●●	T●●●●●A●●T
<i>Lophophorus impeyanus</i>	●●●●●●●●●	●A●●●●●A●	●●●G●●●●●	●●C●●●●●●	●●●●●●●●●	T●●●●●AT●●A
<i>Crossoptilon auritum</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●C●●	●●C●●C●●●	●A●●●●●●●	●●●G●●A●●
<i>Crossoptilon mantchuricum</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●C●●	●●C●●C●●●	●A●●●●●●●	●●●G●●A●●
<i>Crossoptilon c. drouyni</i>	●●●●●G●●●	●A●●●●●A●	T●●●●●C●●	●●C●●C●●●	●A●●●●●●●	●●●●●●A●●
<i>Crossoptilon c. crossoptilon</i>	●●●●●G●●●	●A●●●●●A●	T●●●●●C●●	●●C●●C●●●	●A●●●●●●●	●●●●●●A●●
<i>Tragopan caboti</i>	●●●●●●●●●	●A●●●●●A●	●●●●●●C●●	●●C●●●●●●	●●●●●●●●●	●●●●●●A●●
<i>Tragopan satyra</i>	●●●●●G●●●	●A●●T●●A●	●●●●●●C●●	●●C●●●T●●	●●●●●●●●●	●●●●●●A●●
<i>Tragopan temminicki</i>	●●●●●G●●●	●A●●T●●A●	●●●●●●C●●	●●C●●●T●●	●●●●●●●●●	●●●●●●A●●
<i>Lophura edwardsi</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●A●●	●●C●●C●●●	●●●●G●●●●	●●●●●●A●●
<i>Lophura swinboii</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●A●●G	●●C●●C●●●	●●●●G●●●●	●●●●●●A●●
<i>Syrnaticus ellioti</i>	●●●●●●●●●	●A●●●●●A●	●●●●●●A●●	●●●●●●C●●	●A●●●●●●●	●●●●●●A●T
<i>Syrnaticus humiae humiae</i>	●●●●●●●●●	●A●●●●●A●	●●●●●●A●●	●●●●●●C●●	●A●●●●●●●	●●●●●●A●T
<i>Syrnaticus mikado</i>	●●●●●●●●●	●G●●●●●A●	●●●●●●A●●	●●C●●C●●●	●A●●●●●●●	●●●●●●A●T
<i>Syrnaticus reevesi</i>	●●●●●●●●●	●A●●●●●A●	●●●●●●G●●G	●●C●●C●●●	●A●●T●●●●	●●●●●●A●A
<i>Phasianus colchicus</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●C●●	●●C●●C●●●	●AT●●A●●●	●●●●●●A●A
<i>Catreus wallichii</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●C●●	●●●●●●C●●	●A●●●●●●●	T●●●●●A●●A
<i>Chrysolophus pictus</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●C●●	●●C●●C●●●	●AT●●●●●●	●●●●●●A●●
<i>Chrysolophus p. infuscatus</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●C●●	●●C●●C●●●	●AT●●●●●●	●●●●●●A●●
<i>Chrysolophus p. obscurus</i>	●●●●●●●●●	●A●●●●●A●	T●●●●●C●●	●●C●●C●●●	●AT●●●●●●	●●●●●●A●●
<i>Gallus gallus</i>	ATCCTCTTCC	TAATCCCCIT	CCTCCACAAA	TCTAAACAAC	GAACAATAAC	CTTCCGACCA
<i>Ortalis vetula</i>	●●●●●●●●●	●C●●T●●●●	●●●G●●●●●	●●C●●●●●●	●●●●●●●●●	A●●●●●G●●C
<i>Alectoris chukae</i>	●●●●●TC●T●	●●●●●T●G●	●●●A●●●●●	●●A●●●●●●	●●●●C●●●●	A●●●●●C●●●
<i>Alectoris philbyi</i>	●●●●●AC●T●	●●●●●●A●	●●●A●●●●●	●●A●●●●●●	●●●●C●●●●	A●●●●●C●●●
<i>Afropavo congensis</i>	●●●●●C●TT	●●●●●●T●	●●●●●●●●●	●●●●●●●●●	●●●T●●●●●	A●●●●●C●●●
<i>Pavo cristatus</i>	●●●●●C●TT	●●●●●●T●	●●●●●●●●●	●●C●●●●●●	●●●●C●●●●	A●●●●●T●●●
<i>Polyplectron bicalcaratum</i>	●●●●●C●TT	●●●●●●●●●	●●●●●●●●●	●●C●●●●●●	●●●●C●●●●	A●●T●●C●●●
<i>Pucrasia macrolopha</i>	●●●G●●C●●●	●C●●●●●●●	●●●T●●●●●	●●●●●●●●●	●●●T●●●●●	●●●●●●C●●
<i>Lophophorus impeyanus</i>	●●●●●●C●●●	●T●●T●●●●	●●●T●●●●●	●●●●●●●●●	●●●●C●●●●	A●●●●●T●●●
<i>Crossoptilon auritum</i>	●●●●●●C●●●	●C●●T●●●●	●●●T●●●●●	●●C●●●●●●	●●●●T●●●●	●●●●●●C●●
<i>Crossoptilon mantchuricum</i>	●●●●●●C●●●	●C●●T●●●●	●●●T●●●●●	●●C●●●●●●	●●●●T●●●●	●●●●●●C●●
<i>Crossoptilon c. drouyni</i>	●●●●●●C●●●	●C●●T●●●●	●●●T●●T●●	●●C●●●●●G	●●●●T●●●●	●●●●●●C●●
<i>Crossoptilon c. crossoptilon</i>	●●●●●●C●●●	●C●●T●●●●	●●●T●●●●●	●●C●●●●●G	●●●●T●●●●	●●●●●●C●●
<i>Tragopan caboti</i>	●●●●●●C●●●	●C●●●●●●●	●●●●●●●●●	●●●●●●●●●	●●●●C●●●●	A●●●●●C●●●
<i>Tragopan satyra</i>	●●●●●●C●●●	●C●●●●●●●	●●●T●●●●●G	●●●●●●●●●	●●●●C●●●●	A●●●●●C●●●
<i>Tragopan temminicki</i>	●●●●●●C●●●	●C●●●●●●●	●●●T●●●●●G	●●●●●●●G●	●●●●C●●●●	A●●●●●C●●●
<i>Lophura edwardsi</i>	●●●●●●C●●●	●T●●●●●T●	●●●T●●●●●G	●●●●●●●●●	●●●●C●●●●	●●●T●●C●●●
<i>Lophura swinboii</i>	●●●●●●TC●●	●T●●●●●T●	●●●T●●●●●G	●●●●●●●●●	●●●●C●●●●	●●●T●●C●●●
<i>Syrnaticus ellioti</i>	●●T●●●C●●●	●T●●●●●T●	●●●T●●●●●	●●C●●G●●●●	●●●●C●●●●	●●●T●●T●●●
<i>Syrnaticus humiae humiae</i>	●●T●●●C●●●	●T●●●●●T●	●●●T●●●●●	●●C●●G●●●●	●●●●C●●●●	●●●T●●T●●●
<i>Syrnaticus mikado</i>	●●●●●●C●●●	●T●●●●●●●	●●●●●●●●●	●●C●●●●●●	●●●●C●●●●	●●●●●●T●●●

Appendix Table A. Continued

<i>Syrnaticus reevesi</i>	●●●●●●C●●	●●●●●●●●	●●●T●●●●●	●●C●●●●●●	●●●●●C●●●●●	●●●T●●C●●●
<i>Phasianus colchicus</i>	●●T●●●C●T●	●CC●●●●●●	●●●T●●●●●	●●C●●●●●●	●●●●●T●●●●●	●●●●●●C●●●
<i>Catreus wallichii</i>	●●T●●●C●●●	●C●●●●●●●	●●●T●●T●●●	●●C●●●●●●	●●●●●C●●●●●	●●●●●●C●●●
<i>Chrysolophus pictus</i>	●●●●●●C●●●	●C●●●●●T●●	●●●T●●T●●●	●●C●●●●●●	●●●●●C●●●●●	●●●●●●●●●●
<i>Chrysolophus p. infuscatus</i>	●●●●●●C●●●	●C●●●●●T●●	●●●T●●T●●●	●●C●●●●●●	●●●●●C●●●●●	●●●●●●●●●●
<i>Chrysolophus p. obscurus</i>	●●●●●●C●●●	●C●●●●●T●●	●●●T●●T●●●	●●C●●●●●●	●●●●●C●●●●●	●●●●●●●●●●
<i>Gallus gallus</i>	CTCTCCCAAA	CCCTATTCTG	ACTTCTAGTA	GCCAACCTTC	TTATCCTAAC	CTGAATCGGA
<i>Ortalis vetula</i>	●●●●●●●●●●	T●●●●●●●●	●●●C●●●●●	●●●●●●●●●	●A●●●T●●●●	A●●●G●A●●T
<i>Alectoris chuka</i>	●●●●●●●●●●	●●●●●●●●●●	●●●C●●T●●●	●●T●●●●●●	●●●●●●●●●●	A●●G●●●●●●
<i>Alectoris philbyi</i>	●●●●●●●●●●	●●●●●●●●●●	●●●C●●T●●●	●●T●●●●●●	●C●●●●●●●●	A●●●●●●●●●
<i>Afropavo congensis</i>	●●●●●●●●●●	TT●●T●●●●●	●●TC●●●●●G	●●A●●●●●AT	●C●●●●●●●●	A●●●●●●●●C
<i>Pavo cristatus</i>	●●●●●●●●●●	TT●●C●●T●●	●●●C●●●●●	●●T●●●●●AT	●●●●●●●●●●	A●●●●●●●●C
<i>Polyplectron bicalcaratum</i>	●●A●●●●●●●	T●●●G●●●●●	●●●●●●●●●	●●●●●●●●●	●CG●●●●●●●	●●●●●T●●G
<i>Pucrasia macrolopha</i>	●●●●●●●●●●	●●●●●●●●●●	●●●A●●●●●	●●●●●●●●●	●C●●●T●●●●	T●●●G●●●●
<i>Lophophorus impeyanus</i>	●●●●●●●●●●	●●●●●●●●●●	●●●C●●●●●	●●●●●●●●●	●●●●●●●●●●	T●●●G●A●●●
<i>Crossoptilon auritum</i>	●●T●●●●●GG	●●●●●●●T●●	●T●G●●●●●T	●●●●●●●●●	●C●●●T●●●●	T●●●G●A●●●
<i>Crossoptilon mantchuricum</i>	●●T●●●●●GG	●●●●●●●T●●	●T●G●●●●●T	●●●●●●●●●	●C●●●T●●●●	T●●●G●A●●●
<i>Crossoptilon c. drouyni</i>	●●T●●●●●G	●●●●●●●T●●	●T●G●●●●●T	●●●●●●●●●	●C●●●T●●●●	T●●●G●G●●●
<i>Crossoptilon c. crossoptilon</i>	●●T●●●●●G	●●●●●●●T●●	●T●G●●●●●T	●●●●●●●●●	●C●●●T●●●●	T●●●G●G●●●
<i>Tragopan caboti</i>	●●●●●●●●●●	●T●●●●●●●●	●●●C●●●●●	●●●●●●●●●	●C●●●●●G●●	T●●●G●G●●●
<i>Tragopan satyra</i>	●●●●●●●●●●	●●●●●C●●●●	●●●C●●●●●	●●T●●T●●●●	●CG●●●●G●●	T●●●G●G●●●
<i>Tragopan temminckii</i>	●●●●●●●●●●	●●●●●C●●●●	●●●C●●●●●	●●T●●T●●●●	●CG●●●●G●●	T●●●G●G●●●
<i>Lophura edwardsi</i>	●●T●●●●●●●	●●●●●●●T●●	●T●C●●●●●C	●●T●●●●●C●	●C●●●●●●●●	T●●●G●G●●●
<i>Lophura swinhoii</i>	●●T●●●●●●●	●●●●●●●T●●	●T●C●●G●●C	●●T●●●●●C●	●C●●●●●●●●	T●●●G●A●●●
<i>Syrnaticus ellioti</i>	●●T●●●●●G	●●●●●●●●●●	●●●A●●G●●C	●●●●●●●●●	●C●●●●●●●●	T●●●G●A●●●
<i>Syrnaticus bumiae bumiae</i>	●●●●●●●●G	●●●●●●●●●●	●●●A●●G●●C	●●●●●●●●●	●C●●●●●●●●	T●●●G●A●●●
<i>Syrnaticus mikado</i>	●●●●●●●●G	●●●●●●●T●●	●●●A●●●●●C	A●●●●●●●●●	●C●●●●●●●●	T●●●G●A●●●
<i>Syrnaticus reevesi</i>	●●●●●●●●G	●●T●●●●●T●●	●●●A●●●●●T	●●●●●●●●●	●C●●●T●●●●	T●●●G●A●●●
<i>Phasianus colchicus</i>	●●T●●●●●G	●●●●●●●●●●	G●●A●●●●●T	●●T●●●●●●●	●●●●●●●●●●	●●●●●G●A●●●
<i>Catreus wallichii</i>	●●T●●●●●G	●●●●●●●T●●	●T●A●●●●●C	●●●●●●●●●	●C●●●●●G●●	T●●●G●G●●●
<i>Chrysolophus pictus</i>	●●●●●T●●G	●●●●●●●T●●	●●●A●●●●●C	●●●●●●●●●	●C●●●T●●●●	●●●●●G●A●●●
<i>Chrysolophus p. infuscatus</i>	●●●●●T●●G	●●●●●●●T●●	●●●A●●●●●C	●●●●●●●●●	●C●●●T●●●●	●●●●●G●A●●●
<i>Chrysolophus p. obscurus</i>	●●●●●T●●G	●●●●●●●T●●	●●●A●●●●●C	●●●●●●●●●	●C●●●T●●●●	●●●●●G●A●●●
<i>Gallus gallus</i>	AGCCAACCAG	TAGAACACCC	CTTCATCATC	ATTGGCCAAA	TAGCATCCCT	CTCTTACTTC
<i>Ortalis vetula</i>	●●●●●●●●●●	●C●●●●●●●●	A●●●●●T●●●	●●C●●●●●●C	●●●●●C●●●●●	●A●C●●●●●●●
<i>Alectoris chuka</i>	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	T●●C●●●●●●●
<i>Alectoris philbyi</i>	●●T●●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●●●●●T●●●●	●●●●●●●●●●	T●●C●●●●●●●
<i>Afropavo congensis</i>	●●●●●●●●●●	●●●●●●●●●●	A●●●●●T●●●	●●●●●●●G	C●●●●●●●T	●A●C●●●●●●●
<i>Pavo cristatus</i>	●●T●●●●●●●	●●●●●●●●●●	A●●●●●T●●●	●●C●●●●●G●	●●●●●●●T●	●●C●●●●●●●
<i>Polyplectron bicalcaratum</i>	●●●●●●●●●●	●●●●●●●●●●	T●●●●●●●●	●●●●●●●G	●●●●●●●T●	●●●C●●●●●●
<i>Pucrasia macrolopha</i>	●●●●●●●●●●	●●●●●G●●●●	A●●●●●●●●	●●●●●●●●●	●●●●●●●●●●	●●●C●●●●●●
<i>Lophophorus impeyanus</i>	●●●●●●●●●●	●●●●●●●●●●	A●●●●●T●●C	●●●●●●●●●	●●●●●●●T●	T●●●●●●●●●
<i>Crossoptilon auritum</i>	●●●●●●●●●●	●●●●●G●●●●	A●●●●●●●●	●●C●●●●●●●	●●●●●●●AT●	●●●A●●●●●●
<i>Crossoptilon mantchuricum</i>	●●●●●●●●●●	●●●●●G●●●●	A●●●●●●●●	●●C●●●●●●●	●●●●●●●AT●	●●●A●●●●●●
<i>Crossoptilon c. drouyni</i>	●●●●●●●●●●	●●●●●●●●●●	A●●●●●●●●	●●C●●●●●●●	●●●●●●●AT●	●●●A●●●●●●
<i>Crossoptilon c. crossoptilon</i>	●●●●●●●●●●	●●●●●●●●●●	A●●●●●●●●	●●C●●●●●●●	●●●●●●●AT●	●●●A●●●●●●
<i>Tragopan caboti</i>	●●●●●●●●●●	●●●●●●●T●●	A●●●●●●●●	●●C●●●●●●●	●●●●●●●T●	●●●C●●●●●●
<i>Tragopan satyra</i>	●●●●●●●●●●	●●●●●●●●●●	A●●●●●●●●	●●C●●●●●●●	●●●●●●●T●	●●●C●●●●●●
<i>Tragopan temminckii</i>	●●●●●●●●●●	●●●●●●●●●●	A●●●●●●●●	●●C●●●●●●●	●●●●●●●T●	●●●C●●●●●●
<i>Lophura edwardsi</i>	●●●●●●●●●●	●●●●●●●●●●	A●●●●●●●●	●●C●●●●●●●	●●●●●●●AT●	T●●●A●●●●●●
<i>Lophura swinhoii</i>	●●●●●●●●●●	●●●●●●●●●●	A●●●●●●●●	●●C●●●●●●●	●●●●●●●AT●	T●●●G●●●●●●
<i>Syrnaticus ellioti</i>	●●●●●●●●●●	●C●●●●●●●●	A●●T●●●●●T	●●C●●T●●●●	●●●●●●●A●	T●●●A●●●●●●
<i>Syrnaticus bumiae bumiae</i>	●●●●●●●●●●	●C●●●●●●●●	A●●●●●●●T	●●C●●T●●●●	●●●●●●●A●	T●●●A●●●●●●
<i>Syrnaticus mikado</i>	●●●●●●●●●●	●C●●●●●●●●	A●●T●●●●●T	●●C●●T●●●●	●●●●●●●A●	●●●A●●●●●●
<i>Syrnaticus reevesi</i>	●●●●●●●●●●	●C●●●●●●●●	A●●●●●●●T	●●C●●T●●●●	●●●●●●●A●	●●●A●●●●●●
<i>Phasianus colchicus</i>	●●●●●●●●●●	●●●●●●●●●●	A●●●●●G●●●	●●●●●●●●●	●●●●●●●A●	T●●●A●●●●●●
<i>Catreus wallichii</i>	●●●●●●●●●●	●●●●●●●●●●	G●●●●●●●●●	●●●●●●●●●	●●●●●●●AT●	T●●●A●●●●●●
<i>Chrysolophus pictus</i>	●●●●●●●●●●	●●●●●G●●●●	G●●●●●●●●●	●●●●●●●●●	●●●●●●●AT●	T●●●A●●●●●●
<i>Chrysolophus p. infuscatus</i>	●●●●●●●●●●	●●●●●G●●●●	G●●●●●●●●●	●●●●●●●●●	●●●●●●●AT●	T●●●A●●●●●●
<i>Chrysolophus p. obscurus</i>	●●●●●●●●●●	●●●●●G●●●●	G●●●●●●●●●	●●●●●●●●●	●●●●●●●AT●	T●●●A●●●●●●
<i>Gallus gallus</i>	ACCATCCTAC	TTATCCTCTT	CCCCACAATC	GGAACACTAG	AAAACAAAAT	ACTCAACTAC
<i>Ortalis vetula</i>	●●●●●●●●●●	●CC●●●●●●●	●●●A●TT●CT	●●●G●C●●●●	●●●●●●●●●●	●●●●●T●●C●●
<i>Alectoris chuka</i>	●G●●●●●●●T	●A●●●●●●●●	●●●●●T●●T	●●C●●C●●T●	●●●●●T●●●●	C●●●●●●●●●



**Appendix Table A.** Continued

<i>Alectoris philbyi</i>	●G●●●●●●●T	●A●●●●●●●●	●●●●●T●G●●	●●C●●C●●T●	●●●●●T●●●●●	C●●●●●●●●●
<i>Afropavo congensis</i>	●G●●●●●●●●	●A●●●●●●●●	T●●TG●●●●●	●●●●●TT●●●	●●●●●●●●●	●●●A●●T●●●
<i>Pavo cristatus</i>	●G●●●●●●●T	●A●●●●●●●●	●●●●●TG●●●	●●●●●TT●●●	●●●●●●●●●	●●●A●●●C●●
<i>Polyplectron bicalcaratum</i>	●A●●●●●●●T	●A●●●T●●●●	T●●●●TGGC●	C●●G●●T●●●	●●●●●●●●●	●●●●●●●●●
<i>Puerasia macrolopha</i>	●●T●●●●T●●●	●AT●●●●●●●	●●●●●T●●CT	●C●●●C●●●●	●●●●●●●G●●	●●●T●●TC●●
<i>Lophoborhis impyannus</i>	●●●●●●●●●T	●A●●●●●●T●	●●●●●TG●●T	●●●●●C●●●●	●●●●●●●●●	●●●A●●●CT●
<i>Crossoptilon auritum</i>	●●●●●●●●●●	●A●●●●●●●●	●●●●●G●●G●●	●●●●●C●●●●	●●●●●●●●●	●●●T●●●●●●
<i>Crossoptilon mantchuricum</i>	●●●●●●●●●●	●A●●●●●●●●	●●●●●G●●G●●	●●●●●C●●●●	●●●●●●●●●	●●●T●●●●●●
<i>Crossoptilon c. drouyni</i>	●●●●●●●●●●	●A●●●●●T●●	●●●●●G●●G●●	●●●●●T●●●●	●G●●●●●●●●	●●●●●●●●●
<i>Crossoptilon c. crossoptilon</i>	●●●●●●●●●●	●A●G●●●●TC●	●●●●●G●●G●●	●●●●●T●●●●	●G●●●●●●●●	●●●●●●●●●
<i>Tragopan caboti</i>	●●●●●●●●●●	●C●●●●●●●●	●●●●●T●●C●	A●C●●T●●C●	●●●●●●●●●	●●●●●TC●●●
<i>Tragopan satyra</i>	●●●●●●●●●●	●C●●●●●●●●	●●●●●T●●C●	A●C●●T●●C●	●●●●●●●●●	●●●●●C●●●●
<i>Tragopan temminicki</i>	●●●●●●●●●●	●C●●●●●●●●	●●●●●T●●C●	A●C●●T●●C●	●●●●●●●●●	●T●●●●TC●●
<i>Lophura edwardsi</i>	●●T●●T●●G●	●A●●●●●●●●	●●●●●G●●●●	●●●●●T●●●●	●●●●●●●●●	●●●●●T●●●●
<i>Lophura swinboii</i>	●●T●●T●●●●	●A●●●●●●●●	●●●●●G●●●●	●●●●●T●●●●	●●●●●●●●●	●●●●●T●●●●
<i>Syrnaticus ellioti</i>	●●T●●T●●●●	●C●●●●●●●●	T●●A●●●●●●	●●●●●C●●●●	●●●●●●●●●	●●●●●●●●●
<i>Syrnaticus humiae humiae</i>	●●T●●T●●●●	●C●●●●●●●●	T●●A●●●●●●	●●●●●C●●●●	●●●●●●●●●	●●●●●●●●●
<i>Syrnaticus mikado</i>	●●T●●T●●G●	●C●●●●●●●●	T●●A●●●●●●	●●●●●C●●●●	●●●●●●●●●	●●●●●●●●●
<i>Syrnaticus reevesi</i>	●●T●●T●●●●	●C●●●●●●●●	●●●●●G●●●●	●●●●●C●●●●	●●●●●●●●●	●●●●●●●●●
<i>Phasianus colchicus</i>	●●●●●T●●●●	●C●●●●●●●●	T●●TG●●●●●	●●●●●C●●●●	●●G●●●●●●●	●●●T●●●●●●
<i>Catreus wallichii</i>	●●●●●T●●●T	●AG●●●●●●●	●●●●●●●●●●	●●G●●T●●●●	●●●●●●●●●	●●●●●●●●●
<i>Chrysolophus pictus</i>	●●T●●●●●●●	●A●●●●●●●●	●●●●●G●●●●	●●●●●T●●●●	●●●●●●●●●	●●●●●●●●●
<i>Chrysolophus p. infuscatus</i>	●●T●●●●●●●	●A●●●●●●●●	●●●●●G●●●●	●●●●●T●●●●	●●●●●●●●●	●●●●●●●●●
<i>Chrysolophus p. obscurus</i>	●●T●●●●●●●	●A●●●●●●●●	●●●●●G●●●●	●●●●●T●●●●	●●●●●●●●●	●●●●●●●●●
<i>Gallus gallus</i>	TAA					
<i>Ortalis vetula</i>	●●●					
<i>Alectoris chukra</i>	●●●					
<i>Alectoris philbyi</i>	●●●					
<i>Afropavo congensis</i>	●●●					
<i>Pavo cristatus</i>	●●●					
<i>Polyplectron bicalcaratum</i>	●●●					
<i>Puerasia macrolopha</i>	●●●					
<i>Lophoborhis impyannus</i>	●●●					
<i>Crossoptilon auritum</i>	●●●					
<i>Crossoptilon mantchuricum</i>	●●●					
<i>Crossoptilon c. drouyni</i>	●●●					
<i>Crossoptilon c. crossoptilon</i>	●●G					
<i>Tragopan caboti</i>	●●●					
<i>Tragopan satyra</i>	●●●					
<i>Tragopan temminicki</i>	●●●					
<i>Lophura edwardsi</i>	●●●					
<i>Lophura swinboii</i>	●●●					
<i>Syrnaticus ellioti</i>	●●●					
<i>Syrnaticus humiae humiae</i>	●●●					
<i>Syrnaticus mikado</i>	●●●					
<i>Syrnaticus reevesi</i>	●●●					
<i>Phasianus colchicus</i>	●●G					
<i>Catreus wallichii</i>	●●G					
<i>Chrysolophus pictus</i>	●●G					
<i>Chrysolophus p. infuscatus</i>	●●●					
<i>Chrysolophus p. obscurus</i>	●●●					

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Corresponding Editor: Susan J. Lamont