Journal of Animal Ecology 2000, **69**, 59–73

Are incubation and fledging periods longer in the tropics?

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Summary

1. It is commonly believed that the smaller clutch size of tropical compared with temperate birds is a response to a high predation rate. If this is true, one would expect incubation and fledging periods in the tropics to be shorter than in temperate regions, but they are generally thought to be longer in the tropics than in northern temperate areas.
2. In this paper we show that among passerines in both the Old and the New World, there is little or no difference in either incubation or fledging periods between temperate and tropical areas.
3. We suggest that tropical birds differ from temperate ones in their clutch size and extended post-fledging periods, which is necessary for juvenile survival, but probably not in other life history parameters.

Key-words: clutch size, eggs, fledging, incubation, tropics.

Journal of Animal Ecology (2000) **69,** 59–73

Introduction

It is commonly believed that tropical and southern temperate birds differ from northern temperate ones in several life history parameters: having smaller clutch size (Moreau 1944; Lack 1947, 1968; Ricklefs 1980; Klomp 1970; Murray 1985), laying more clutches per year (Lack & Moreau 1965; Ricklefs 1969), having longer incubation and fledging periods (Skutch 1949; Lack 1968; Ricklefs 1968; Woinarski 1985), and better survival rates (Cody 1966; Ricklefs 1973; Murray 1985; Skutch 1985). Skutch (1949) suggested that some of these differences are due to greater predation in the tropics, but Martin (1996) noted a paradox; if predation is the key factor determining clutch size, then incubation and fledging periods in the tropics should be shorter than in temperate regions, but they are generally thought to be longer in the tropics and in southern temperate areas. Other possible factors for expecting longer incubation and fledging periods in the tropics are smaller clutch (and litter) size in the tropics, which is often associated with longer developmental periods, and the possibility that tropical birds lay larger eggs, whose embryos take longer to develop (Rahn & Ar 1974).

However, the claim that incubation and fledging periods are longer in the tropics is based on relatively small samples (Skutch 1949, 1985; Lack 1968; Ricklefs 1968; Mason 1985; Woinarski 1985). This note tests this claim for a large sample size of tropical and northern temperate passerine species. This was done by examining incubation and fledging periods on both sides of the Atlantic Ocean, in the Old World (Europe and East Africa) and in the New World (North America and Central America). The two regions differ in the composition of their respective avifaunas; whereas the great majority of passerines in the Old World belong to the suborder Oscines, many of the passerines in the New World (but very few in the Old World) belong to the suborder Deutro-Oscines, and this phylogenetic factor was also considered in the examination of the data.

Materials and methods

SPECIES AND STUDY AREAS

Data on body mass, clutch size, egg volume, and incubation and fledging periods were gathered for four regions. Temperate northern regions were represented by Europe and North America (Canada, USA and northern Mexico), and the tropics were represented by East Africa (Ethiopia,

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Kenya, Tanzania and Uganda) and Central America (from Guatemala to Panama, inclusive).

For the New World, we selected infra-orders that are represented in both North America and Central America. The Deutro-Oscines were represented by the Furnarii and Tyranni (including the families Furnariidae, Dendrocolaptidae, Formicariidae, Rhynocryptidae, Contigidae, Pipridae, Tyrannidae and Phytotomidae) and the Oscines by various New World families, including the Vireonidae, Fringillidae, Drepanididae, Parulidae, Coerebidae, Thraupidae, Embrizidae and Icteridae. For Europe and East Africa, whose avifaunas do not have Deutro-Oscines, we selected the following oscine families: Alaudidae, Hirundinidae, Motacillidae, Pycnonotidae, Troglodytidae, Prunellidae, Sylviidae, Timaliidae, Paridae, Sittidae, Certhiidae, Laniidae, Zosteropidae, Ploceidae and Fringillidae. This selection was done because we found more data on these families than on any others. Due to lack of data on the length of incubation and fledging periods of southern South America passerines, we did not extend the analysis to southern temperate species.

VARIABLES SELECTED

Body mass

Data on body mass were gathered from various sources: Perrins (1987), Cramp & Simmons (1988, 1992), and Cramp & Perrins (1993, 1994a,b) for Europe; Keith, Urban & Fry (1992) and Urban, Fry & Suart (1997) for East Africa; and Ricklefs (1976), Stiles & Skutch (1989) and Wetmore (1972, 1984) for Central America. Schönwetter (1967–83) and Dunning (1993) complemented missing data for all regions. When more than one value was given for a parameter, a mean was calculated. When available we used female mass, but for many species the above sources do not provide female mass, and in such cases we used the data available (males or unspecified sex).

A possible source of error in our data is the parameter of mean body mass, which is affected by various factors. Sexual dimorphism among passerines is generally small (Campbell & Lack 1985), and among 112 European and American species of our sample for which we have data of body mass for both sexes, males are on average 3·8% ± 9·9 (SD) heavier than females, but in 33 (29%) out of the of the above 112 species females are heavier than males. Other factors may change body mass by 10% or more, as is evident in the chapters dealing with body mass of various species in Cramp & Simmons (1988, 1992) and in Cramp & Perrins (1993, 1994a,b). In several passerines, sexual dimorphism varies within species; in some samples males are heavier while in others females are heavier (Cramp & Perrins 1993; 1994a,b). Migrants may gain or loose up to 40% of their mass during migration (Berthold 1993); breeding birds may loose a considerable proportion of their mass, while incubating or feeding their young, and even outside the breeding season body mass may fluctuate by as much as 10% within 1 day (Yom Tov & Hilborn 1981).

Clutch size, incubation period, fledging period and egg volume

The above sources (apart from Dunning 1993) also provide some data on clutch size, egg size, incubation and fledging periods, which were complemented with data from Harrison (1975), Cramp & Simmons (1988, 1992) and Cramp & Perrins (1993, 1994a,b) for Europe, Baicich & Harrison (1997), Ehrlich, Dobkin & Wheye (1988) and Robbins, Bruun & Zim (1966) for North America, Curson, Quinn & Beadle (1994), Hilty & Brown (1986), Howell & Webb (1995), Isler & Isler (1987), Skutch (1949, 1954, 1960, 1967, 1969, 1972, 1976, 1981a, 1981b, 1985) for Central America, and Mackworth-Praed & Grant (1960), Keith *et al.* (1992) and Urban *et al.* (1997) for East Africa. Data on egg length and width were complemented from Schönwetter (1967–1983). When a range of clutch size was given, a mean was calculated from the common range and the word 'sometimes' received a score of 0·3 egg, i.e. if a clutch size was said to be 2, sometimes 1, it received a value of 1·7. Similarly, a clutch of 2, sometimes 3, is scored 2·3. Egg volume was calculated using the equation Volume = $0{\cdot}5 \times \text{Length} \times \text{Width}^2$, which is a good approximation of both egg volume and egg mass (van Noordwijk *et al.* 1981).

STATISTICS

In this analysis we examined the regional change in mean body mass, egg mass, clutch size, incubation and fledging periods of the above mentioned three major groups of passerines (see appendix). We examined, separately for each group of birds, regional differences (within the Old and New World) in each of the four variables using *t*-tests on log-transformed data. In the next step, we removed the effect of body mass prior to testing for regional differences by using residuals from a regression of each of the four variables on body mass. Last, to control for the effect of phylogeny we used the CAIC program (Purvis & Rambaut 1995), which implements the independent contrasts method (Felsenstein 1985). This method identify comparisons that can safely be regarded as statistically independent based on a given phylogenetic tree. The methods implemented in the CAIC program work best when the variables used are continuous or categorical (preferably dichotomous). Polytomies (nodes with more than two daughter branches) that express ignorance of the true branching structure are treated in CAIC according to Pagel (1992). Dendrograms (topologies and branch lengths), based on DNA-DNA hybridizations, provided in Sibley & Ahlquist (1990; Figs 371–373, 380–382, 384, 385) were used for determining phylogenetic relationships among species. Species not mentioned or specified (represented only as genus) in Sibley & Ahlquist (1990) dendrograms were treated as sister taxa within their genus. Branch lengths for such species were estimated as mean branch length within the genus (in cases, where other species within the genus were indicated) or as the mean branch length within all genera outlined in the dendrogram (in cases where no other species within the genus were indicated).

For each group of birds we examined the relationship between (1) body mass (independent variable) and four other dependent variables (egg mass, clutch size, incubation period, and fledging period) by linear regression, and (2) contrasts of body mass (independent variable) and the contrasts of the other four dependent variables (egg mass, clutch size, incubation period and fledging period) by linear regression through the origin. We performed these initial steps to examine the effect of body mass on other variables before and after the phylogenetic component was removed. All analyses were performed on log-transformed data.

For our regional comparisons we assigned a value of zero to all temperate species and a value of one to all tropical species, thus creating a categorical character with only two states. Using the Brunch option in CAIC, we compared, separately for each group of birds, all four dependent variables between regions. The null hypothesis is that evolution in the dependent variable (e.g. egg mass) has not been linked to region or latitude, thus we should expect half the contrasts in the dependent variable to be positive and half negative, and the mean value of the contrasts to be zero. We tested the null hypothesis using a *t*-test on the mean of the contrasts (Purvis & Rambaut 1995). A mean significantly greater than zero indicates that in the tropics the values of the dependent variable are larger, whereas a mean significantly below zero indicates larger values of the dependent variable in temperate zones.

Results

Linear regression analyses indicated that only egg mass increased significantly with body mass ($r = 0{\cdot}71$–$0{\cdot}94$; Table 1; Fig. 1) in all groups, even after adjusting for phylogeny. Clutch size is independent of body mass in the Deutro-Oscines, even after adjusting for phylogeny. In the Old and New World Oscines, there was a significant increase in clutch size with body mass. However, this was no longer the case for the Old World Oscines after removing the phylogenetic component (Table 1; Fig. 1). Incubation period was dependent on body mass in the New World Oscines, but variable in the other groups (Table 1; Fig. 1). Fledging period increased significantly with body mass in the Deutro-Oscines and New World Oscines, but not in the Old World Oscines (Table 1; Fig. 1).

Table 1. Regression coefficients of body mass (independent variable) on four reproductive-related dependent variables (clutch size, egg mass, incubation period and fledging period) in three groups of passerines (New World Deutro-Oscines, New World Oscines, Old World Oscines). Linear regressions were performed on the raw data (log-transformed) and on the independent contrasts (regression through the origin)

	Raw data						Contrasts				
	Slope	Intercept	*r*	*F*	d.f.	*P*	Slope	*r*	*F*	d.f.	*P*
New World Deutro-Oscines											
Clutch size	–0·04	0·45	0·09	1·1	120	0·300	–0·11	0·08	0·5	71	0·484
Egg mass	0·77	–0·58	0·94	842·7	103	< 0·001	0·51	0·72	66·7	63	< 0·001
Incubation period	0·10	1·06	0·45	16·6	65	< 0·001	0·04	0·24	2·9	46	0·096
Fledging period	0·15	1·00	0·42	15·2	70	< 0·001	0·16	0·41	9·8	50	0·003
New World Oscines											
Clutch size	–0·15	0·72	0·33	16·7	136	< 0·001	– 0·29	0·27	5·1	63	0·028
Egg mass	0·64	–0·47	0·93	807·7	125	< 0·001	0·42	0·71	59·6	60	< 0·001
Incubation period	0·06	1·02	0·40	19·1	101	< 0·001	0·06	0·39	9·4	51	0·003
Fledging period	0·16	0·87	0·44	23·6	96	< 0·001	0·12	0·33	6·3	51	0·015
Old World Oscines											
Clutch size	–0·15	0·72	0·21	7·6	170	0·006	0·02	0·03	0·1	71	0·800
Egg mass	0·71	–0·62	0·93	1020·4	169	< 0·001	0·63	0·91	367·0	72	< 0·001
Incubation period	–0·02	1·15	0·11	1·2	95	0·286	0·09	0·41	10·3	51	0·002
Fledging period	0·05	1·12	0·11	1·1	98	0·291	0·08	0·26	3·8	55	0·055

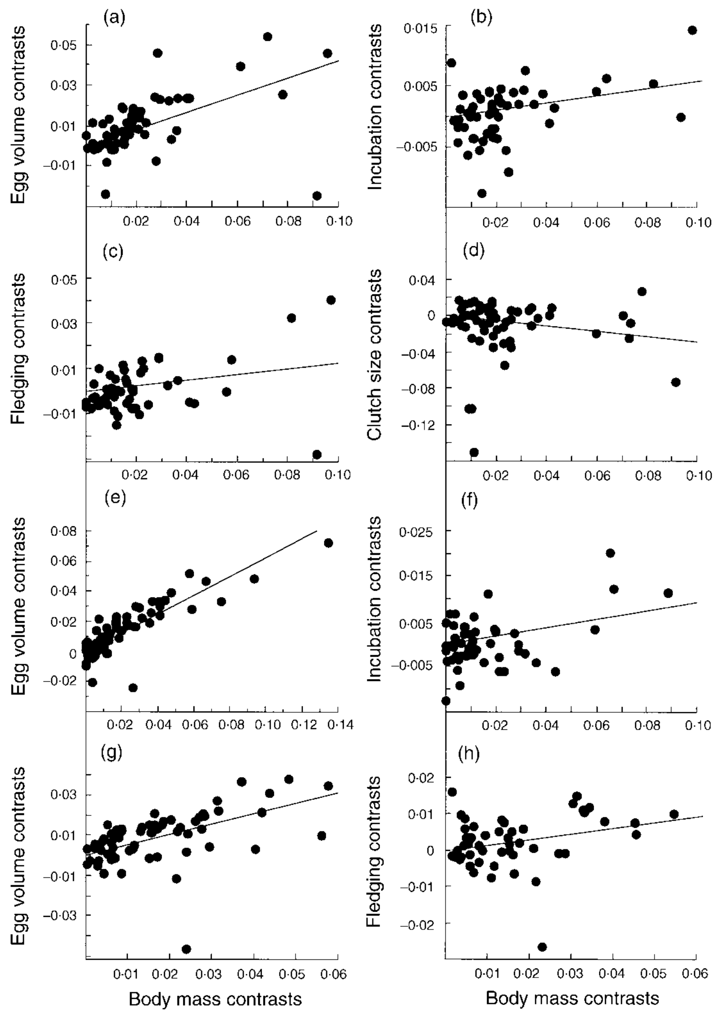

Fig. 1. Linear regressions through the origin of body mass contrasts and contrasts of the four dependent variables examined. Only the significant associations are presented (statistical parameters are presented in Table 1). Plots labelled A–D are for the New World Oscines, E and F are for the Old World Oscines, and those labelled G and H are for the New World Deutro-Oscines.

Following Lack (1947) and many others, Martin (1996) stated that clutch sizes of most tropical and southern hemisphere birds were smaller than in related birds from north temperate regions. This was confirmed in all three presented analyses, where clutch size was significantly smaller in the tropics than in northern temperate regions in both the Old and New Worlds (means of raw data in the tropics were significantly smaller, and mean contrasts ranged −0·034 to −0·059 and were significantly less than zero; Table 2). In the New World, clutch size was significantly smaller in Central America than in North America in both Deutro-Oscines and Oscines (Table 2). In the Old World clutch size was significantly smaller in East Africa than in Europe (Table 2).

The analysis of independent contrasts also indicated that there were no significant differences in egg mass among Oscines or Deutro-Oscines in the New World, nor between the Oscines of Europe and East Africa (Table 2). Incubation period differed significantly between tropical and temperate zone only among New World Oscines, but after controlling for body mass this difference was no longer significant at the 0·05 level (Table 2). A significant difference in fledging period was detected only between passerines from East Africa and Europe (Table 2).

Discussion

The above results confirm the well known observations that clutch size in the tropics is smaller than in north temperate regions (Yom-Tov 1987, 1994). However, the claim that incubation and fledging periods are longer in the tropics is not universally supported, and tend to be similar in the tropics and northern temperate areas. Furthermore, our analysis suggests that the observed regional difference in incubation and fledging periods, noted in previous studies, can be accounted for by phylogeny.

Table 2. Differences (t-tests) between temperate and tropical zones on four reproductive-related variables (clutch size, egg mass, incubation period and fledging period) for three groups of passerines (New World Deutro-Oscines, New World Oscines, Old World Oscines). t-Tests were performed on the raw data (log-transformed), on residuals with body mass, on independent contrasts and on contrasts controlled for body mass (see text for details). A mean contrast significantly greater than zero indicates that in the tropics the values of the dependent variable are larger, whereas a mean contrast significantly below zero indicates larger values of the dependent variable in temperate zones

	Raw data			Raw data controlled for body mass			Contrasts				Contrasts controlled for body mass			
	t	d.f.	P	t	d.f.	P	Mean	t	d.f.	P	Mean	t	d.f.	P
New World Deutro-Oscines														
Clutch size	12.6	120	< 0.001	12.4	120	< 0.001	–0.059	5.8	11	< 0.001	–0.059	5.9	11	< 0.001
Egg mass	1.8	103	0.076	3.9	103	< 0.001	–0.009	2.1	10	0.066	–0.006	0.9	10	0.410
Incubation period	4.9	65	< 0.001	4.9	65	< 0.001	0.002	1.8	5	0.139	0.002	1.3	5	0.262
Fledging period	0.8	70	0.401	0.4	70	0.697	–0.001	0.3	7	0.798	–0.002	0.4	7	0.723
New World Oscines														
Clutch size	16.4	136	< 0.001	15.2	136	< 0.001	–0.048	4.6	14	< 0.001	–0.045	4.2	14	< 0.001
Egg mass	2.2	125	0.032	0.0	125	0.983	0.004	0.9	12	0.370	–0.009	1.3	12	0.229
Incubation period	5.7	101	< 0.001	4.8	101	< 0.001	0.004	2.6	6	0.039	0.003	1.6	6	0.170
Fledging period	6.8	96	< 0.001	6.2	96	< 0.001	0.006	1.0	7	0.364	0.002	0.3	7	0.810
Old World Oscines														
Clutch size	17.5	191	< 0.001	16.4	170	< 0.001	–0.034	6.3	15	< 0.001	–0.031	5.7	15	< 0.001
Egg mass	0.2	192	0.827	3.1	169	0.002	0.003	0.6	15	0.528	–0.000	0.0	15	0.960
Incubation period	1.0	96	0.336	1.0	95	0.326	0.000	0.3	8	0.793	0.000	0.2	8	0.807
Fledging period	2.3	99	0.019	2.3	98	0.023	0.006	2.3	9	0.044	0.006	2.2	9	0.051

Martin (1996), reviewing the present knowledge on life history parameters of tropical birds, concluded that many perceived differences between tropical and southern temperate birds on one hand, and northern temperate ones on the other, may not actually exist, or at the very least are unclear. The claim that tropical birds have higher renesting rates and more broods per year is also not uniformly supported. Skutch (1954) found that ground-nesting warblers (Parulidae) were single-brooded in Central America, as they are in North America. Even the opposite trend exists; African Stonechats (*Saxicola torquata* L) were single-brooded in equatorial Africa but multi-brooded in the Palearctic (Dittami & Gwinner 1985). Similarly, Karr *et al.* (1990) provided a detailed comparison of survival rates of tropical and temperate forest birds and found no significant difference in adult survival rates [but see Faaborg & Arendt (1995) for higher survival rates in Puerto Rico, a tropical island in comparison with both Panama and Maryland]. The difference in clutch size between tropical and temperate area birds was often related to higher predation rates in the tropics (Lack 1968). This claim is questionable in light of the similar nesting success of thrushes (*Turdus* sp.) in north temperate areas and in Trinidad (Snow & Snow 1963), and of higher predation rates reported in north temperate, rather than in tropical species of *Catharus* (Skutch 1981a,b; Martin 1993). Furthermore, Skutch (1985) has shown that clutch size does not differ among Neotropical locations that differ markedly in predation rates. Hence, it seems that the only proven consistent difference in life history parameters between southern temperate/tropical regions and northern temperate ones is the smaller clutch size of tropical birds. The smaller clutch size of tropical birds could have been a factor contributing to longer developmental periods, but apparently this is not the case.

Larger birds lay larger eggs which have longer incubation and produce chicks, which have longer fledging period (Rahn & Ar 1974; Yom-Tov & Ar 1993). However, we found no difference in egg size between temperate and tropical regions, and this factor cannot contribute to a difference in developmental periods between the regions.

If tropical and temperate region birds do not differ in the rate of renesting and survival, nor in the length of incubation and fledging, but do differ in clutch size, one would expect higher population growth in temperate areas (Bennett & Harvey 1986; Karr *et al.* 1990). This has not been reported, implying that other life history components may differ between the two areas. Such components might include juvenile survival and age to sexual maturity. Anecdotal evidence suggests that tropical birds have extended post-fledging periods and that young birds tend to stay longer around their parents than do young birds in the temperate zones. These behavioural differences are selectively advantageous for juvenile survival in the tropics (Fogden 1972; Skutch 1976; Wolf, Ketterson & Nolan 1988; Brosset 1990; Karr *et al.* 1990). Badyaev (1997) suggested that at high elevations, juvenile survival is greater as a result of prolonged post-fledging parental care and shorter natal dispersal, thus compensating for reduced fecundity in high elevation finches. Similar reasoning may also explain the reproductive pattern of tropical passerines. Following Karr *et al.* (1990), we emphasize the need to consider and study the above mentioned and other life history components.

Acknowledgements

We wish to thank Fritz Hertel, Arnon Lotem, Mark Pagel, Jon Wright and Nomi Paz for their comments on the manuscript, and to Arieh Landesman for his help with compiling the raw data from the literature.

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Received 29 July 1998; revision received 8 March 1999

Appendix 1

Region of sampled birds, body mass (g), clutch size, egg mass (g), incubation period (days) and fledging period (days) for 142 species of New World Oscines, 200 species of Old World Oscines and 121 species of New World Deutro-Oscines. NA = North America, CA = Central America, Eu = Europe and EA = East Africa.

Species	Region	Body mass	Clutch size	Egg mass	Incubation period	Fledging period
New World Oscines						
Agelaius phoeniceus	CA	64·0	2·5	3·74	11·0	11·0
Agelaius phoeniceus	NA	42·0	3·5	4·19	11·0	12·5
Agelaius tricolor	NA	49·0	3·5	3·82	12·0	12·5
Arremonops conirostris	CA	37·0	2·3	4·20	13·5	11·5
Arremonops fufivirgatus	CA	25·0	2·5	3·19		
Arremonops rufivirgatus	NA	24·0	4·0	2·99		
Basileuterus culicivorus	CA	10·5	3·0	1·86		
Basileuterus melanogenys	CA	13·0	2·0	2·14		
Basileuterus rufifrons	CA	11·5	2·5	1·92		12·0
Basileuterus rufifrons	NA	11·0	4·0			
Basileuterus tristrianus	CA	12·0		1·75		
Cacicus uropygialis	CA	68·0	2·0			
Calamospiza melanocorys	NA	38·0	4·5	3·14	11·5	8·5
Calcarius lapponicus	NA	27·0	4·5	2·51	12·5	9·0
Calcarius mccownii	NA	23·0	3·5	2·48	12·0	11·0
Calcarius ornatus	NA	19·0	4·0	2·03	11·5	11·5
Calcarius pictus	NA	26·0	4·0	2·55	11·5	12·0
Cardinalis cardinalis	NA	44·0	3·5	4·58	12·5	9·5
Cardinalis sinuatus	NA	35·0	2·5	4·07	14·0	10·0
Carduelis flammea	NA	13·0	4·5	1·40	10·5	12·0
Carduelis hornemanni	NA	13·0	4·5	1·45	11·0	11·5
Carduelis lawrencii	NA	11·0	4·5	1·10	12·5	12·0
Carduelis pinus	NA	15·0	3·5	1·39	13·0	14·5
Carduelis psaltria	CA	10·0	3·5	1·06		
Carduelis psaltria	NA	9·0	4·5	1·03	12·0	11·0
Carduelis tristis	NA	13·0	5·0	1·32	11·0	14·0
Carduelis xanthogastra	CA	12·0	2·5	1·37		
Carpodacus cassini	NA	26·0	4·5	2·25	13·0	14·0
Carpodacus mexicanus	NA	21·0	4·5	4·19	13·0	15·0
Carpodacus purpureus	NA	25·0	4·5	2·34	13·0	14·0
Chlorothraupis carmioli	CA	38·0	2·0	3·54		
Chondestes grammacus	NA	29·0	4·5	2·69	11·5	9·5
Coereba flaveola	CA	9·5	2·0	1·33	12·5	16·5
Cyanerpes cyaneus	CA	13·5	2·0	1·74	12·5	14·0
Cyanerpes lucidus	CA	11·0	2·0		12·5	13·5
Dendroica caerulescens	NA	10·0	4·0	1·49	12·5	11·5
Dendroica castanea	NA	13·0	4·5	1·55	12·5	11·5
Dendroica cerulea	NA	9·0	4·0	1·49	12·0	10·0
Dendroica chrysoparia	NA	10·0	3·5	1·62	12·0	9·0
Dendroica coronata	NA	12·0	4·5	1·66	12·5	11·0
Dendroica discolor	NA	8·0	4·0	1·26	12·0	9·5
Dendroica dominica	NA	9·0	4·0	1·52	12·0	10·0
Dendroica fusca	NA	10·0	4·0	1·47	11·0	
Dendroica graciae	NA	8·0	4·0	1·43		
Dendroica kirtlandii	NA	14·0	4·5	1·90	14·5	12·5
Dendroica magnolia	NA	9·0	4·0	1·31	12·0	10·0
Dendroica nigrescens	NA	12·0	4·0	1·35		
Dendroica occidentalis	NA	9·0	4·5	1·53	12·0	8·0
Dendroica palmarum	NA	10·0	4·5	1·52	12·0	12·0
Dendroica pensylvanica	NA	10·0	4·0	1·37	12·5	11·0
Dendroica petechia	NA	10·0	4·5	1·43	11·5	12·5
Dendroica pinus	NA	12·0	4·0	1·73	10·0	10·0
Dendroica striata	NA	13·0	4·5	1·78	12·0	11·5
Dendroica tigrina	NA	11·0	6·5	1·33		
Dendroica townsendii	NA	9·0	4·5	1·52	12·0	8·0
Dendroica virens	NA	9·0	4·5	1·44	12·0	9·0
Diglossa plumbea	CA	9·0	2·0			
Dolichonyx oryzovorus	NA	42·0	5·5	2·82	11·5	12·0
Eucometis penicillata	CA	31·0	2·3	3·58	15·0	11·5
Euphonia affinis	CA	10·5	2·5			

Appendix 1 (cont'd)

Species	Region	Body mass	Clutch size	Egg mass	Incubation period	Fledging period
Euphonia elegantissima	CA	15·0	3·0	1·54		
Euphonia gouldi	CA	12·0	3·0			
Euphonia hirundinacea	CA	15·0	4·0	1·50	16·0	17·0
Euphonia imitans	CA	14·0	2·5	1·61		
Euphonia laniirostris	CA	15·0	4·0	1·42	14·5	20·5
Euphonia luteicapilla	CA	12·5	3·0	1·21	13·5	23·0
Euphonia minuta	CA	10·0	4·0	1·22	16·0	19·0
Habia fuscicauda	CA	40·0	2·5	4·89	13·0	
Habia leucothorax	CA	40·0	2·0			
Habia rubica	CA	38·0	2·3	3·81	13·5	
Helmitheros vermivorsus	NA	13·0	4·5	1·69	13·0	10·0
Icteria virens	NA	25·0	3·5	3·25	11·0	8·0
Icterus cucullatus	NA	24·0	3·5	2·60	13·0	14·0
Icterus dominicensis	CA	32·0		3·06		
Icterus galbula	NA	33·0	4·5	3·10	13·0	13·0
Icterus graduacauda	NA	42·0	4·0	4·08		
Icterus gullaris	NA	55·0	3·5	5·00	14·0	
Icterus mesomelas	CA	70·0	3·0	3·79	14·0	12·5
Icterus parisorum	NA	37·0	3·0	3·45	13·0	14·0
Icterus pectoralis	NA	44·0	2·0	4·35		13·0
Icterus pectoralis	CA	50·0		4·21		
Icterus spurius	NA	19·0	4·0	2·23	12·0	12·5
Junco hyemalis	NA	20·0	4·0	2·13	12·5	11·0
Junco phaenotus	NA	20·0	3·5	2·38	15·0	10·0
Junco vulcani	CA	28·0	2·0			
Leucosticte arctoa	NA	25·0	4·5	4·10	13·0	18·0
Melospiza georgiana	NA	17·0	4·5	2·22	13·5	12·0
Melospiza lincolnii	NA	17·0	4·5	2·10	13·0	10·5
Melospiza melodia	NA	21·0	3·5	2·34	13·0	10·5
Myioborus miniatus	CA	10·0	2·7	1·55	14·0	13·0
Myioborus pictus	NA	8·0	3·5	1·42	13·5	11·0
Myioborus torquatus	CA	11·0	2·5	1·49	15·0	13·0
Oryzoborus funereus	CA	13·5	2·0			
Oryzoborus nuttingi	CA	24·0	2·0			
Peucedramus taeniatus	NA	11·0	3·5	1·47		
Pheucticus ludovicianus	NA	46·0	4·0	4·08	13·5	10·5
Pheucticus melanocephalus	NA	42·0	3·5	4·18	12·5	11·5
Pheucticus tibialis	CA	70·0	2·0			
Pinicola enucleator	NA	56·0	4·0	4·66	14·0	16·5
Piranga bidentata	CA	38·0	2·5	4·12		
Piranga flava	CA	40·0	2·0	3·63		
Piranga flava	NA	38·0	4·0	3·66	13·0	
Piranga leucoptera	CA	15·0		3·11		
Piranga ludoviciana	NA	28·0	4·0	3·37	13·0	13·0
Piranga olivacea	NA	29·0	4·0	3·31	13·5	10·0
Piranga rubra	NA	28·0	4·0	3·50	12·0	10·0
Plectrophenax hyperboreus	NA	54·0	5·0	3·32	10·0	10·0
Plectrophenax nivalis	NA	42·0	5·5	3·21	13·0	13·5
Pooecetes gramineus	NA	25·0	3·5	2·52	12·0	9·0
Protonotaria citrea	NA	16·0	5·0	2·08	13·0	11·0
Psarocolius montezuma	CA	520·0	2·0	12·71	17·5	30·0
Psarocolius wagleri	CA	225·0	2·0	7·82	17·0	33·0
Rhamphocelus passerinii	CA	31·0	2·0	3·38	12·0	12·0
Sicalis luteola	CA	11·0	4·0	1·67		
Spizella arborea	NA	20·0	4·0	2·21	12·5	9·0
Spizella atrogularis	NA	12·0	3·0	1·63	13·0	
Spizella breweri	NA	11·0	3·5	1·38	12·0	8·5
Spizella pallida	NA	12·0	3·5	1·46	11·0	8·5
Spizella passerina	NA	12·0	4·0	1·55	12·5	10·0
Spizella pusilla	NA	12·0	4·0	1·71	12·0	7·5
Tachyphonus delattrii	CA	19·0	2·0			
Tachyphonus luctuosus	CA	16·0	3·0	3·32		
Tachyphonus rufus	CA	32·0	2·0	3·56	14·5	
Tanagra dowii	CA	20·0	2·0			
Tanagra guttata	CA	20·0	2·0	2·52	13·0	15·0
Tanagra gyrola	CA	23·0	2·0	1·69	13·5	15·5

Appendix 1 (cont'd)

Species	Region	Body mass	Clutch size	Egg mass	Incubation period	Fledging period
Tanagra icterocephala	CA	21·0	2·0	2·59	14·0	15·0
Tanagra inorata	CA	19·0	2·0			
Tanagra larvata	CA	19·0	2·0	2·21	14·0	15·0
Tanagra lavinia	CA	24·0	3·0			
Thraupis episcopus	CA	32·0	2·0	3·49	13·5	18·0
Thraupis palmarum	CA	38·0	2·0	3·61	14·0	18·0
Vermivora bachmanii	NA	9·0	4·0	1·27	11·0	10·0
Vermivora cellata	NA	9·0	4·5	1·33	13·0	9·0
Vermivora chrysoptera	NA	9·0	4·5	1·47	10·0	9·5
Vermivora crissalis	NA	10·0	4·0	1·75	10·5	11·0
Vermivora luciae	NA	7·0	4·0	0·99		
Vermivora peregrina	NA	10·0	5·5	1·29	11·0	11·0
Vermivora pinus	NA	8·0	5·0	1·27	10·5	9·0
Vermivora ruficapilla	NA	9·0	4·5	1·23	11·5	11·0
Vermivora virginiae	NA	8·0	4·0	1·27	13·0	11·5
Volatinia jacarina	CA	9·5	2·5	1·31	11·0	9·0
Old World Oscines						
Acrocephalus arundinaceus	Eu	31·0	5·0	3·15	14·5	12·0
Acrocephalus baeticatus	EA	10·3	2·5	1·29	13·0	14·0
Acrocephalus dumetorum	Eu	12·0	4·5	1·68		11·0
Acrocephalus gracilirostris	EA	16·5	2·5	1·89		
Acrocephalus melanopogon	Eu	11·5	3·5	1·60		
Acrocephalus paludicola	Eu	12·0	5·5	1·49		13·5
Acrocephalus palustris	Eu	13·0	4·5	1·85	12·0	12·0
Acrocephalus rufescens	EA	19·0	2·5	2·46	14·0	
Acrocephalus schoeobaenus	Eu	11·5	5·5	1·65	13·5	13·0
Acrocephalus scirpaceus	Eu	12·5	4·0	1·75	11·5	12·0
Alauda arvensis	Eu	39·0	4·0	3·35	11·5	19·0
Amblyospiza albifrons	EA	35·8	3·0	2·70	15·0	20·0
Anthoscopus caroli	EA	6·5	6·0	0·61		
Anthoscopus musculus	EA		4·0	0·65		
Anthus caffer	EA	16·0	2·5	1·64		
Anthus campestris	Eu	24·0	4·5	2·73	13·5	
Anthus cervinus	Eu	19·5	5·5	2·01	13·0	12·0
Anthus leucophrys	EA	29·5	3·0	2·39		
Anthus melindae	EA	22·5	2·5	2·32		
Anthus novasseelandiae	Eu	32·0	5·0	2·54	14·0	16·0
Anthus pratensis	Eu	20·5	4·5	2·06	13·5	13·5
Anthus similis	EA	26·0	2·5	2·70	13·5	14·0
Anthus spinoletta	Eu	25·5	4·5	2·73	14·0	16·0
Anthus trivialis	Eu	22·5	5·0	2·44	13·5	12·5
Anthus vaalensis	EA	29·4	2·5	2·57		
Apalis caniceps	EA	7·9	2·5	0·94		
Apalis chariessa	EA		3·0	1·03		
Apalis cinerea	EA	10·0	3·0	0·99	13·5	15·5
Apalis flavida	EA	8·3	3·0	0·99	13·0	16·0
Apalis flavigularis	EA	10·5	2·5	1·48		
Apalis jacksoni	EA	8·5	2·0			
Apalis melanocephala	EA	8·4	2·5	1·12		
Apalis murina	EA	10·5	2·5	1·44	17·0	16·0
Apalis pulchra	EA	10·3	2·3	1·30	13·5	15·5
Apalis rufifrons	EA	7·0	4·5	0·88		
Bleda syndactyla	EA	45·6	2·0	4·47		
Bubalornis niger	EA	81·3	3·3	5·60	11·0	21·5
Camaroptera brachyura	EA	9·3	3·0	1·29	14·5	14·5
Camaroptera brevicauda	EA	12·0	2·0	1·15		
Camaroptera chloronota	EA	11·4	2·0	1·37		
Certhia brachydactyla	Eu	10·0	6·5	1·05	15·0	16·5
Certhia familiaris	Eu	10·0	5·5	1·13	14·5	14·5
Cisticola angusticauda	EA		3·0	0·88		
Cisticola aridula	EA	8·1		0·96	14·0	18·0
Cisticola ayresii	EA	6·7	3·5	1·09	11·0	
Cisticola brachyptera	EA	8·3	3·0	1·06		
Cisticola brunnescens	EA	8·0	3·5	1·37	12·0	13·0
Cisticola cantans	EA	11·9	2·5	1·33	13·0	16·0

Appendix 1 (cont'd)

Species	Region	Body mass	Clutch size	Egg mass	Incubation period	Fledging period
Cisticola carruthersi	EA	10·8	3·5	1·15		
Cisticola chiniana	EA	12·8	4·3	1·44		14·0
Cisticola chubbi	EA	17·5	1·5	1·73		
Cisticola cinereola	EA	15·2	2·0	1·26		
Cisticola emini	EA	13·7	3·0	1·69		
Cisticola erythrops	EA	13·6	3·0	1·45	16·0	14·0
Cisticola galactotes	EA	12·9	3·0	1·33	19·0	14·0
Cisticola hunteri	EA	15·1	2·3	1·37	12·5	17·0
Cisticola juncidis	EA	8·0	4·5	0·91	13·5	12·5
Cisticola lais	EA	10·8	3·5	1·44		
Cisticola nana	EA	5·0	4·0	0·96		
Cisticola natalensis	EA	15·4	3·0	1·91		14·0
Cisticola robusta	EA	15·0	2·5	1·86		
Cisticola tanniens	EA	12·9	4·0	1·15		
Eminia lepida	EA	18·4	2·5	1·78	12·5	16·0
Eremophila alpestris	Eu	39·0	4·0	3·30	12·0	12·0
Euplectes afra	EA	15·5	3·0	1·29	13·0	11·0
Euplectes capensis	EA	16·5	2·5	2·25	14·5	15·5
Euplectes gierowii	EA			2·25		
Euplectes hordeacea	EA	18·4	3·0	1·48	12·0	11·0
Euplectes nigroventris	EA		2·5	1·22		
Euplectes orix	EA	15·5	3·0	1·29	12·5	13·5
Galerida cristata	Eu	40·0	4·0	3·24	12·5	14·0
Galerida thecklae	Eu	37·5	4·0	3·21	12·5	14·0
Hippolais icterina	Eu	14·0	4·5	1·70	13·0	13·0
Hippolais olivetorum	Eu	18·0	3·5	2·25		
Hippolais pallida	Eu	11·5	3·5	1·54	12·5	12·0
Hippolais polyglotta	Eu	12·0	4·0	1·60	12·5	12·5
Hirundo abyssinica	EA	12·5	3·0	1·78	14·0	23·0
Hirundo aethiopica	EA	15·3	2·7	1·48	14·0	25·0
Hirundo angolensis	EA	18·0	3·0	1·69	17·5	23·0
Hirundo daurica	EA	22·4	4·5	2·05	14·5	26·5
Hirundo griseopyga	EA	9·5	2·5	1·22		
Hirundo rustica	Eu	20·5	5·0	1·90	15·0	20·5
Hirundo semirufa	EA	29·5	3·0	2·82	16·0	24·0
Hirundo senegalensis	EA	43·4	2·7	2·48		
Hirundo smithii	EA	11·1	3·0	1·48	16·0	20·0
Mirafra africana	EA	40·3	2·5	2·77		12·0
Mirafra africanoides	EA	23·1	2·4	2·21	12·0	12·0
Mirafra albicauda	EA	21·3	2·0	1·67		
Mirafra cantilans	EA	18·8	3·0	1·93		
Mirafra collaris	EA		2·7	2·25		
Mirafra hypermetra	EA	44·0	3·0	3·94		
Mirafra poecilosterna	EA	24·4	2·0			
Mirafra ruficinnamomea	EA	26·9	2·2	2·28		
Motacilla aguimp	EA	26·0	3·5	2·76	13·5	15·5
Motacilla alba	Eu	23·0	5·5	2·30	13·5	15·0
Motacilla capensis	EA	20·9	3·0	2·36	14·0	15·0
Motacilla cinerea	Eu	19·0	5·0	1·91	13·5	12·0
Motacilla clara	EA	15·0	2·5	2·46	13·5	14·0
Motacilla flava	Eu	19·0	5·5	1·90	13·0	13·0
Nicator chloris	EA	38·2	2·0	3·20		
Parus afer	EA	19·8	3·0	1·72		
Parus albiventris	EA		4·0			
Parus ater	Eu	9·0	9·0	1·04	14·0	17·5
Parus caeruleus	Eu	10·5	9·0	1·14	13·5	19·0
Parus cinctus	Eu	14·0	7·5		14·0	
Parus cristatus	Eu	11·5	6·5	1·27	14·0	18·0
Parus fringillinus	EA		3·0	1·55		
Parus leucomelas	EA	16·1	5·0	1·96		
Parus lugubris	Eu	16·5	6·0			
Parus major	Eu	18·5	8·0	1·68	13·0	20·0
Parus montanus	Eu	10·5	7·5	1·23	13·0	18·0
Parus palustris	Eu	10·5	7·0	1·23	13·0	17·0
Passer domesticus	Eu	27·0	4·5	2·89	13·0	15·0
Passer gongonensis	EA		2·5	2·48		

Appendix 1 (cont'd)

Species	Region	Body mass	Clutch size	Egg mass	Incubation period	Fledging period
Passer griseus	EA	23·9	3·5	2·40		
Passer hispaniolensis	Eu	27·0	5·5	2·74	12·0	13·5
Passer montanus	Eu	22·0	5·0	2·11	13·0	13·0
Passer rufocinctus	EA		3·5	2·42		
Petronia petronia	Eu	30·5	5·5	2·82	16	21
Petronia xanthosterna	EA	18·1	3·0	1·81		
Phyllastrephus cabanisi	EA	23·5	2·3	3·07	11·5	17·0
Phyllastrephus cerviniventris	EA	23·5	2·0	3·01		
Phyllastrephus debilis	EA	13·3	2·0	1·69		
Phyllastrephus flavostriatus	EA	28·9	2·0	3·09		
Phyllastrephus terrestris	EA	29·1	2·1	3·43		
Phylloscopus bonelli	Eu	8·0	5·0	1·20		
Phylloscopus borealis	Eu	10·5	5·5	1·32		
Phylloscopus collybita	Eu	7·5	5·5	1·13	13·0	13·5
Phylloscopus sibilatrix	Eu	9·5	6·0	1·32	13·0	11·5
Phylloscopus inornatus	Eu	6·5	5·5	0·91		
Phylloscopus trochiloides	Eu	8·0	5·0	1·07		
Phylloscopus trochilus	Eu	8·0	6·5	1·20	13·0	13·5
Ploceopasser donaldsoni	EA			2·70		
Ploceopasser mahali	EA	41·7	2·3	2·70	14·0	22·0
Ploceopasser superciliosus	EA	34·8	2·0	2·59		
Ploceus bicolor	EA	33·1	2·0	2·36		
Ploceus bojeri	EA		2·5	2·11		
Ploceus capitalis	EA		2·0	2·31		
Ploceus castaneiceps	EA		2·5	2·59		
Ploceus cuculatus	EA	36·6	3·0	3·40	12·0	19·0
Ploceus heuglini	EA	24·7	2·5	2·48		
Ploceus intermedius	EA	21·2	2·0	2·59		
Ploceus jacksoni	EA		2·5	2·21		
Ploceus luteolus	EA	12·7	2·5	1·52		
Ploceus nigriceps	EA		2·3	2·70		
Ploceus rubiginosus	EA	28·6	3·5	2·48		
Ploceus spekei	EA	30·5	2·0	2·76		
Ploceus vitellinus	EA		3·0	1·82		
Prinia bairdii	EA	13·9	3·0	1·25	12·0	
Prinia leucopogon	EA	13·5	2·5	1·26		
Prinia somalica	EA	7·5	3·5	0·94		
Prinia subflava	EA	9·2	3·0	0·99	13·5	15·0
Prunella collaris	Eu	30·0	3·5	3·38	15·0	16·0
Prunella modularis	Eu	21·5	4·5	2·13	12·0	12·0
Pycnonotus barbatus	EA	34·0	2·5	2·98	12·5	13·5
Quelea cardinalis	EA		2·5	1·33	13·0	16·5
Quelea erythrops	EA	15·4	2·0	1·52		13·0
Quelea quelea	EA	18·3	4·0	1·30	11·0	12·0
Regulus ignicapillus	Eu	6·5	8·0	0·69	14·5	19·5
Regulus regulus	Eu	6·5	7·5	0·77	16·0	19·0
Riparia cincta	EA	24·6	3·5	2·37		22·5
Riparia paludicola	EA	11·9	3·0	1·29		
Riparia riparia	Eu	15·0	4·5	1·43	14·0	19·0
Salpornis spilonota	EA	14·0	3·0	1·52		
Seicercus ruficapillus	EA		2·5	1·44		
Seicercus umbrovirens	EA		2·5	1·48		
Sitta europaea	Eu	21·5	6·5	2·08	14·5	24·0
Sitta neumayer	Eu	30·0	8·0	2·43		
Sitta whiteheadi	Eu	12·5	5·5	1·47		23·5
Spermophaga ruficapilla	EA	21·8	3·5			
Sylvia atricapilla	Eu	17·0	4·5	2·19	11·0	11·5
Sylvia borin	Eu	19·5	4·5	2·23	12·0	11·0
Sylvia communis	Eu	15·0	4·5	1·78	12·0	11·0
Sylvia conspicillata	Eu	9·0	4·5	1·37	13·0	12·5
Sylvia cantillans	Eu	11·0	3·5	1·42	11·5	11·5
Sylvia curruca	Eu	13·0	5·0	1·40	11·0	11·0
Sylvia hortensis	Eu	21·5	4·5	2·10	12·0	13·0
Sylvia melanocephala	Eu	11·0	3·5	1·73	11·5	11·5
Sylvia melanothorax	Eu	11·5	4·5	1·68		
Sylvia nisoria	Eu	28·0	5·0	2·36	13·5	13·5

Appendix 1 (cont'd)

Species	Region	Body mass	Clutch size	Egg mass	Incubation period	Fledging period
Sylvia rüppelli	Eu	13·4	4·5	1·76	13·0	
Sylvia sarda	Eu	10·0	3·5	1·52		
Sylvia undata	Eu	10·5	4·0	1·56	12·5	14·0
Sylvietta brachyura	EA	8·0	2·0	1·26		
Sylvietta isabellina	EA	10·0	2·0	1·26		
Sylvietta leucophrys	EA	10·4	2·0	1·08		
Sylvietta whytii	EA	9·9	2·0	1·37	14·0	17·0
Tichodroma muraria	Eu	17·5	4·0	2·33	18·5	23·5
Troglodytes troglodytes	Eu	10·5	5·5	1·32	14·5	16·5
Turdoides hindei	EA			4·21		
Turdoides hypoleuca	EA		3·3	4·69		
Turdoides jardinei	EA	56·3	3·0	4·15		
Turdoides melanops	EA		2·5	5·20		
Turdoides plebeja	EA	67·5	3·0	4·87		
Turdoides squamulata	EA	69·0		4·69		
Vidua fischeri	EA	13·6		1·21		
Vidua macroura	EA	14·4		0·88		20·0
Zosterops kikuyuensis	EA		2·0	1·18		
Zosterops senegalensis	EA	10·9	2·5	1·08	11·0	14·0
Zosterops virens	EA	13·4	2·0	1·15		
New World Deutro-Oscines						
Attila spadiceus	CA	40·0	3·5	3·96	18·0	18·0
Automolus ochrolaemus	CA	42·0	2·5	5·21	20·5	18·0
Automolus rubiginosus	CA	52·0	2·0	6·82		
Camptostoma imberbe	CA	7·5	2·0	1·29		
Camptostoma imberbe	NA	7·0	3·0	1·30		
Camptostoma obsoletum	CA	7·5	2·0		15·0	16·5
Capsiempis flaveola	CA	8·0	2·0	1·48	15·5	
Chiroxiphia lanceolata	CA	19·0	2·0	2·59		
Chiroxiphia linearis	CA	19·0	2·0			
Contopus borealis	NA	32·0	3·0		14·0	22·0
Contopus cinereus	CA	12·5	2·5	1·56		
Contopus pertinax	NA	27·0	3·5	2·77		
Contopus sordidulus	NA	13·0	3·0		12·5	16·0
Contopus virens	NA	14·0	3·0	1·77	12·5	16·0
Coryphotriccus albovittatus	CA	24·0	2·0			
Cranioleuca erythrops	CA	16·0	2·0	2·95		
Dendrocincla anabatica	CA	40·0	2·0	5·31	21·0	18·0
Dendrocincla fuliginosa	CA	42·0	2·0	4·75		
Dendrocincla homochroa	CA	44·0	2·5			
Dendrocincla longicauda	CA	24·0	2·0	3·15		
Dendrocolaptes certhia	CA	73·0	2·0			
Dendrocolaptes picumnus	CA	65·0	2·0	6·81		
Dysithamnus mentalis	CA	14·5	2·0	2·12	15·0	9·0
Dysithamnus puncticeps	CA	17·0	2·0			
Dysithamnus striaticeps	CA	17·0	2·0		14·0	11·0
Elaenia chiriquensis	CA	17·5	2·0	1·81	14·5	16·0
Elaenia flavogaster	CA	25·0	2·0	2·84	15·5	17·5
Elaenia frantzii	CA	20·0	2·0	2·34	15·0	14·0
Empidonax albigularis	CA	12·0	2·0	1·46		
Empidonax alnorum	NA	13·0	3·5	1·75	12·5	13·5
Empidonax atriceps	CA	9·0	2·0	1·76		
Empidonax difficilis	NA	10·0	3·5	1·52	17·5	16·0
Empidonax flavescens	CA	12·0	2·5	1·81		17·0
Empidonax flaviventris	NA	12·0	3·5	1·64	12·5	13·5
Empidonax fulvifrons	NA	8·0	4·0	1·15	14·5	15·5
Empidonax hammondii	NA	10·0	3·5	1·45	13·5	17·5
Empidonax minimus	NA	10·0	4·0	1·39	13·5	14·0
Empidonax oberholiseri	NA	10·0	3·5		13·5	18·0
Empidonax trailii	NA	13·0	3·5	1·68	12·5	13·0
Empidonax virescens	NA	13·0	3·0	1·86	14·0	14·0
Empidonax wrightii	NA	12·0	3·5	1·60	14·0	16·0
Formicarius analis	CA	60·0	2·0	10·33		
Formicarius nigricapillus	CA	70·0	2·0	7·59	20·0	18·0
Glyphorhynchus spirurus	CA	16·5	2·0	1·61		

Appendix 1 (cont'd)

Species	Region	Body mass	Clutch size	Egg mass	Incubation period	Fledging period
Grallaria guatemalensis	CA	98·0	2·0	11·27		
Gymnopithys leucaspis	CA	30·0	2·0	3·89	15·5	14·0
Hylophylax naevioides	CA	18·0	2·0	2·76		11·0
Lepidocolaptes affinis	CA	35·0	2·0	6·64	17·0	19·0
Lepidocolaptes souleyetii	CA	28·0	2·0	4·50	15·0	19·0
Leptopogon amaurocephalus	CA	10·0	2·5	2·04		
Leptopogon superciliaris	CA	12·0	2·0	2·08		
Lipaugus unirufus	CA	75·0	1·0	7·50	25·5	28·5
Manacus aurantiacus	CA	15·5	2·0	2·53	19·0	14·0
Manacus candei	CA	18·5	2·0			
Megarhynchus pitangua	CA	70·0	2·5	6·81	17·0	24·0
Mionectes olivaceus	CA	14·5	2·5	1·92	20·0	19·0
Myiarchus cinerascens	NA	27·0	4·5	3·42	15·0	15·0
Myiarchus crinitus	NA	33·0	5·0	3·65	14·0	16·5
Myiarchus nuttingi	CA	24·0	4·0	2·93		
Myiarchus panamensis	CA	32·0	2·5			
Myiarchus tuberculifer	CA	20·0	3·0	3·77		13·0
Myiarchus tuberculifer	NA	20·0	4·5		14·0	14·0
Myiarchus tyrannulus	CA	34·0	3·0	3·43		
Myiarchus tyrannulus	NA	44·0	4·5	3·60	14·0	16·5
Myiodynastes hemichrysus	CA	41·0	3·0			
Myiodynastes luteiventris	CA	45·0	2·5	4·76	16·0	
Myiodynastes luteiventris	NA	46·0	3·5	5·11	15·5	17·0
Myiodynastes maculatus	CA	45·0	2·5	4·48	16·0	18·0
Myiopagis viridicata	CA	13·0	2·0	1·46		
Myiozetetes granadensis	CA	30·0	2·5	3·37	16·5	20·0
Myiozetetes similis	CA	27·0	3·0	3·02	15·5	18·0
Myrmeciza exsul	CA	28·0	2·0	3·20		
Myrmeciza laemosticta	CA	25·0		2·94		
Myrmotherula axillaris	CA	8·5	2·0	1·34		
Myrmotherula fulviventris	CA	10·5	2·0	1·63		
Myrmotherula schisticolor	CA	9·5	2·0	1·55	15·0	
Pachyramphus cinnamomeus	CA	22·0	3·5			21·0
Pachyramphus polychopterus	CA	21·0	3·5	2·16	18·5	21·0
Pachyramphus versicolor	CA	14·0	2·0	1·94		
Philydor rufus	CA	34·0	2·0	3·61		
Pipra coronata	CA	12·0	2·0	2·73	18·0	15·0
Pipra mentalis	CA	16·0	2·0	2·50		12·0
Pipra pipra	CA	14·0		1·87		
Pitangus sulphuratus	CA	68·1	3·0	5·55		
Pitangus sulphuratus	NA	61·0	4·5	6·85	16·0	15·0
Premnoplex brunnescens	CA	17·0	2·0	2·93		
Pseudocolaptes lawrencii	CA	48·0	1·0	4·62		29·0
Pyrocephalus rubinus	NA	14·0	3·0	1·65	14·5	15·0
Querula purpurata	CA	115·1	1·0			
Sayornis nigricans	CA	21·0	2·5	2·01	16·0	15·5
Sayornis nigricans	NA	19·0	4·0	2·12	16·0	17·5
Sayornis phoebe	NA	20·0	4·5	2·12	16·0	15·5
Sayornis saya	NA	21·0	4·5	2·30	13·0	15·0
Schiffornis turdinus	CA	35·0	2·0	3·71	20·5	15·0
Sclerurus albigularis	CA	38·0	2·0	5·07		
Sclerurus guatemalensis	CA	35·0	2·0	5·93	21·0	15·0
Sclerurus mexicanus	CA	28·0	2·0			
Sittasomus griseicapilus	CA	14·0		2·25		
Sublegatus modestus	CA	13·5	2·0	1·83		
Synallaxis albescens	CA	13·0	2·3	2·31		
Synallaxis brachyura	CA	18·5	2·5	2·90	18·5	17·0
Synallaxis erythrothorax	CA	15·0	3·0	2·94	17·5	16·0
Thamnophilus bridgesti	CA	27·0	2·0	4·18	14·5	10·0
Thamnophilus doliathus	CA	28·0	2·3	3·45		12·5
Thamnophilus punctatus	CA	24·0	2·0	3·37	14·0	9·0
Thripadectes rufobrunneus	CA	54·0	2·0	7·16		
Tityra inquisitor	CA	50·0	3·0			25·0
Tityra semifasciata	CA	87·9	2·0	6·62	21·0	29·0
Todirostrum cinereum	CA	6·5	2·5	1·09	17·5	18·0
Todirostrum nigriceps	CA	6·3		0·97		

Appendix 1 (cont'd)

Species	Region	Body mass	Clutch size	Egg mass	Incubation period	Fledging period
Todirostrum sylvia	CA	7·5	2·0	1·37	18·5	20·0
Tyrannulus elatus	CA	8·0	2·0	1·14		
Tyrannus couchii	NA	45·0	3·5	4·41		
Tyrannus dominicensis	NA	44·0	3·5	3·40	17·0	18·0
Tyrannus forficatus	NA	43·0	4·0		15·5	15·0
Tyrannus melancholicus	CA	40·0	2·5	4·09	15·5	19·0
Tyrannus melancholicus	NA	37·0	3·5	4·10	15·5	18·5
Tyrannus savana	CA	28·0	2·5			
Tyrannus tyrannus	NA	44·0	3·5	4·18	17·0	17·0
Tyrannus verticalis	NA	40·0	3·5	3·88	18·5	16·5
Tyrannus vociferans	NA	46·0	3·5	3·73	18·5	16·5
Xenops minutus	CA	12·0	2·0		16·0	13·5
Xenops rutilans	CA	13·0	2·0	2·41		
Xiphorhynchus erythropygius	CA	50·0	2·0	4·05		
Xiphorhynchus flavigaster	CA	60·0		6·46		
Xiphorhynchus guttatus	CA	48·0	2·0	5·37	18·0	20·0
Xiphorhynchus lachrymosus	CA	57·9	2·0			