Taxonomy, Phylogeny, and Biogeography of the Andean Hummingbird Genera *Coeligena* LESSON, 1832; *Pterophanes* GOULD, 1849; *Ensifera* LESSON 1843; and *Patagona* GRAY, 1840 (Aves: Trochiliformes)

Dissertation

zur

Erlangung des Doktorgrades (Dr. rer. nat.)

der

Mathematisch-Naturwissenschaftlichen Fakultät der

Rheinischen Friedrich-Wilhelms-Universität Bonn

vorgelegt von

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Valencia, Venezuela

Bonn, August 2003

Angefertigt mit Genehmigung
der
Mathematisch-Naturwissenschaftlichen Fakultät
der
Rheinischen Friedrich-Wilhelms-Universität Bonn

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Tag der Promotion: 26. September 2003

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Introduction

The phylogeny and biogeography of tropical birds has been, and still is an important theme during the past two decades, retaining its validity partially thanks to the continuing discovery of new taxa. Unfortunately the taxa discovery rate is not coupled to the gain in knowledge in the fields of phylogeny and biogeography. This is especially true in the Neotropical region, so the design and elaboration of studies on such themes becomes especially relevant.

The long and complex geological history of the South American continent has led to the formation of a great variety of habitats, resulting in a proliferation of plant and animal species, putting this zone in the category of "the region with the highest diversity on the planet" (e.g., c. 3300 bird species have been documented for the Neotropics, in contrast with 1600 within the Afrotropis, 961 in the Oriental Region, and 906 in the Australasian, Schuchmann 1990). One of the Neotropical groups which responded rapidly and spectacularly to the high number of available habitats was the birds, which can be found in an enormous number of forms (highly specialised or generalists) occupying almost every available niche.

To understand the history of the Andean biota it is necessary to review the general historical background of the South American continent. Geological data show that high-Andean habitats have been available for plant colonisation only since the end of the Tertiary (late Miocene – Pliocene, *c.* 11.2 Ma). Although the uplift of the Andes began in the late Cretaceous (*c.* 70 Ma), the final uplift throughout the range took place at the end of the Pliocene and the beginning of the Pleistocene (*c.* 2.6 Ma), ending with the uplift of the northern Andes (Simpson 1975, Van der Hammen 1989). Thus the current evidence indicates a recent south-to-north pattern of Andean uplift (Doan 2003). Based on this south-to-north progression, it is likely that high-elevation habitats were available for colonisation first in the south, then more recently (Pleistocene) in the north. The action of erosion and high-energy streams and rivers, together with water accumulation in the highlands, resulted in the excavation of major canyons, increasing the effectiveness of barriers to dispersal of the species that colonised the high-Andean habitats (Johnson 2002).

Many hypotheses explaining the origin of the Andean avifauna have been based mainly on the effects of Pleistocene climatic fluctuations on speciation processes (e.g., Avise & Walker 1998, Vuilleumier 1968). However, other authors propose that many Andean genera and species have had a much longer occupancy in the region and an autochthonous origin (before

the Pleistocene). The possibility that ancient groups of birds responded directly to the orogenic activity in their habitat could be a consequence of this proposal (Graves 1985).

In many cases, the Refugia Theory (Haffer 1969), together with palaeoclimatological data, have been employed in order to explain Andean bird speciation patterns. These hypotheses present a notable incoherence: the palaeoclimates are documented for the highlands but the supposed refugia are documented for the lowlands (Shapiro 1989). From this perspective it is logical to propose an early origin for high-Andean taxa.

Three different kinds of processes modify the geographical spatial arrangement of organisms: extinction, dispersal and vicariance (Crisci 2001). The latter has been considered an alternative method of understanding the historical biogeography of Andean biota; in many taxa vicariance is seen as the cause of biota differentiation (vicariant biogeography), implying the occurrence of parapatric or allopatric speciation. This approach does not exclude the effect of climatic or other factors in the formation of new taxa, but the driving force is always vicariance. It is now generally acknowledged, since Nelson's (1969) contributions on cladistical biogeography, that the interdependence between geographical distribution and phylogeny is fundamental to biogeographic analyses. Based on this relationship, several methods have been proposed to investigate the origin of extant taxa and the presence and localisation of ancestral areas (Bremer 1992; Ronquist 1994, 1995; Sober 1988; Wiley 1988; and recently van Veller *et al.* 1999, 2002).

The presence of bird species before the Pleistocene strongly supports the use of vicariance hypotheses in order to explain the differentiation patterns observed in the Andes, patterns that would be directly related to the geological history of the region. This approach is known as the South-to-North Speciation Hypothesis (SNSH), which proposes that speciation of high-Andean taxa followed a south-to-north pattern, generally coinciding with the progression of uplift of the Andes (Doan 2003). The same process has been proposed by García-Moreno & Fjeldså (2000) to explain the radiation of the Andean avifauna.

For several genera from the non-hermits hummingbirds lineage, a speciation model that coincids with the SNSH's south-to-north radiation general statement has been proposed, This conclusion has been achieved in biogeographic studies made on *Aglaiocercus* (Schuchmann & Duffner 1993), member of the Andean 'coquettes' lineage (*sensu* Bleiweiss *et al.* 1997), and on other related Andean genera as *Chalcostigma* (Schuchmann & Heindl 1997) and *Metallura* (Heindl & Schuchmann 1998). In these studies the radiation scenario is placed basically in the Pleistocene, the center of origin for the taxa is supposed to be in south of the

equator (somewhere in southeastern Peru and northeastern Bolivia), and a northward direction for the speciation process is proposed. In these mentioned studies, the location of the centre of origin is explained by the presence of plesiomorphic characters in the southern taxa populations. The direction of dispersal is justified with the observed northward gradual progression of apomorphic characters.

Coeligena species (Aves: Trochiliformes) were probably one of those ancestral bird groups that radiated into high-Andean habitats during the orogenic formation activity, making it a good group to study in an approach to the general biogeographic history of the Andes. The current taxonomy of the genus *Coeligena* was established by Peters (1945), and the most recent taxonomic arrangement, presented by Schuchmann (1999), includes 12 species, all distributed on the Andean slopes and adjacent mountain ranges, from the north-eastern Venezuelan Cordillera de la Costa to northern Argentina, including the isolated Sierra de Santa Marta in north-eastern Colombia (Fjeldså & Krabbe 1990, Schuchmann 1999, Sibley & Monroe 1990).

There are numerous studies on the systematic and geographic variation of Andean hummingbird genera other than *Coeligena* (e.g., Graves 1980). Specific studies on *Coeligena* species are limited to hybrid forms (Graves 2001), nest descriptions (Ortiz-Crespo 2000, Schuchmann 1978, Wiedenfeld 1985), or ethology (Schuchmann 1975). No studies exist on the phylogeny of *Coeligena* and its relationship to other Trochilinae lineages. There is some evidence (based mainly on plumage coloration) indicating possible phylogenetic relationships between the well-established genus *Coeligena* and the genera *Pterophanes*, *Ensifera* (Berlioz 1936), and possibly *Patagona* (Schuchmann, pers. comm.).

Within the last few decades, there has been an increase in the number of studies using phylogenies to address a wide range of issues (especially biogeography), but even with the advances in molecular technology, phylogenetic hypotheses do not exist for most of the world's taxa. Where they do exist, these studies often do not include all taxa that are of interest to the researcher (Kennedy & Page 2002). For the Trochilidae in particularly, only studies on systematic relationships in higher taxomomic categories (subfamily and genera groups) have been performed. Using anatomical evidence, Zusi & Bentz (1982) include *Coeligena*, *Pterophanes*, *Ensifera*, and *Patagona* within the group possesing a type 3 tensor patagii brevis muscle (TPB), characteristic for members of the subfamily Trochilinae. Based on DNA-hybridisation evidence, Bleiweiss *et al.* (1994, 1997) included *Coeligena* within the non-hermit lineage of the Andean 'brilliants', which include the genera *Heliodoxa* and

Eriocnemis, but data from the genera *Pterophanes*, *Ensifera*, and *Patagona* were not included, their position in the Trochilidae phylogeny being still unclear.

This study presents a phylogenetic hypothesis for *Coeligena* species and their relatedness to the genera *Pterophanes*, *Ensifera*, and *Patagona*. This hypothesis represents an "only one phylogeny" (*sensu* Hennig 1950) approach to the *Coeligena* that can be corroborated or falsified with other reconstructions based on character data sets (morphological as well as molecular data sets) different from those employed in this study.

This study also presents a biogeographic hypothesis for *Coeligena*, *Pterophanes*, *Ensifera*, and *Patagona* species based on the assumption that the historical biogeography of the group has been directly influenced or determined by their phylogeny (see below). When the latter is resolved, it will be possible to proceed with the reconstruction of the speciation processes and the causes of the current geographic distribution.

To carry out this study, the following assumptions were adopted:

1. Phenotypic variation within and between populations is coupled with the genotypic variation via the environmental effects on the expressivity and penetrance of genes. Variations in external morphology consistently reflect genetic variation. The lower the morphologic variation between populations, the higher the degree of relatedness.

2. The evolutionary unit is the species, defined under the Biological Species concept. Reproductive isolation could not be tested on living populations, nevertheless it was considered to be a product of geographic isolation. Sympatric species not showing interbreeding are considered reproductively isolated. This assumption indirectly implies the possible preference for the Phylogenetic Species Concept in the absence of reproductive isolation evidence.

3. Reconstructions of the phylogeny using the phenotypic features (plumage coloration patterns) is possible. These reconstructions are based on the proportion of shared and unique derived characters between groups. The presence of a phenotype and its frequency of occurrence within the population tells us much about its evolutionary development, it being possible to define the phenotypic characters present in all (or almost all) group members as ancestral (plesiomorphies), and the less common shared characters as more modern and derived (synapomorphies). This latter shows finer and closer relationships between groups.

4. The geographic isolation of a population and its subsequent reproductive isolation are products of the geological and geographic history of the area it occupies. Changes in topology, landscape, and climate model the distribution pattern and speciation process of the biota, vicariance being the main modelling factor.

5. A unique group phylogeny corresponds with a unique biogeography, but the history of an area is independent of the taxa inhabiting it, thus taxa sharing the same area might also share analogous biogeographic histories. If this is true, any approach that trys to explain the biogeography and speciation scenario of a single Andean bird must be able to explain the evolutionary scenarios of any other Andean group. This capacity would confer a predictive quality on the biogeographic hypothesis.

In this study, the first methodological step was the analysis of geographical variation within the species of the genera *Coeligena*, *Pterophanes*, *Ensifera*, and *Patagona*, in order to detect and clarify possible taxonomic problems and to assess the validity of group designations at specific and subspecific levels. Geographical variation in external morphological characters was assessed and the degree of isolation and probable gene flow interruption caused by geography determined.

On the basis of the results, it was decided whether the distinct taxomomic units considered as valid in modern classifications could be promoted to species rank, could be considered as valid subspecies, or rather as an artefact caused by information gaps (the consequences of poor sampling or of lack of availability of material for the researcher during this study).

Once the definitive taxonomic units (species) were obtained, it was possible to perform the phylogenetic reconstruction of the *Coeligena* species as well as the remaining genera *Pterophanes*, *Ensifera*, and *Patagona*. The reconstruction was achieved using plumage coloration and by constructing a character matrix that included all the species of the four genera. A maximum parsimony phylogeny was constructed as a first approach to the understanding of the relationships between the groups.

The biogeography and speciation scenario reconstruction is based on the phylogenetic hypothesis, the result of the phylogenetic analysis. The geological history of the Andes was used as the framework for the explanation of the distribution and speciation patterns within the study group. This reconstruction represents a biogeographic hypothesis for the genus *Coeligena*, and is considered to have predictive power if applied to other related Andean hummingbirds.

The work is structured in four chapters, each containing different aspects of the study: 'Material and Methods', 'Species Accounts: Discussion on the Taxomomy and the Geographic Variation of the Morphometric and Coloration Characters', 'Phylogenetic Relationships, Biogeography and Radiation Scenarios', and 'Taxomomic Conclusions'.

The first chapter, 'Material and Methods', describes how the data werw obtained and the methodology employed for the analysis.

The second chapter, 'Species Accounts', provides the results of the geographic variation analysis (morphology and coloration patterns), with each species presented as a separate sub-chapter, including distribution maps. In this chapter, the taxonomy and systematic relationships are analysed and criticised and when, necessary, new taxomomic proposals are presented.

The third chapter is divided into two sections:

⇒ The first section presents the results of the phylogenetic analysis, introducing the hypothesis to be subsequently used in the biogeographic analysis.

⇒ The second section presents the results of the biogeographic analysis. Here the probable radiation scenario the *Coeligena* group is presented. This scenario is congruent with the geological history of the area and the phylogenetic hypothesis obtained in this study.

The fourth chapter, 'Taxomic Conclusions', summarises the taxomomic status of all analysed species, including proposed changes.

The last section includes summaries in English and German and the appendix, which is composed of a detailed presentation of the data used in the analyses, and the statistical results not included in the main text, organised according to the taxomomic changes proposed.

Materials and Methods

1. Specimens Data

A total of 1773 specimens was measured and described: 1320 of *Coeligena*, 106 of *Ensifera*, 123 of *Pterophanes*, and 224 of *Patagona*.

1.1 Museum Material

Material measured and described for this study was available in the following museums and ornithological collections listed in alphabetical order (acronyms in parenthesis):

- American Museum of Natural History (AMNH)
- Academy of Natural Sciences of Philadelphia (ANSP)
- Colección Ornitológica Phelps (COP)
- Field Museum of Natural History (FMNH)
- Forschungsinstitut Senckenberg (SMF)
- Museo de Historia Natural de la Universidad de San Marcos "Javier Prado" (MUSM)
- Muséum National d'Histoire Naturelle, Paris (MHNP)
- Museum of Comparative Zoology (MCZ)
- National Museum of Natural History-Smithsonian Institution (NMNH)
- Naturhistorisches Museum in Wien (NMW)
- Zoologisches Forschungsinstitut und Museum Alexander Koenig (ZFMK)
- Zoologisk Museum København (ZMK)
- The Natural History Museum, Tring (NHM)

The information obtained directly from skins, as well as from the labels accompanying the study specimens, involved morphometric data, sex, age, collection-site, collecting date, and collector. All this data was analysed in the following way:

1.2 Sex and Age Determination

Information on the sex of the skins was obtained from the label. In the case of false, dubious or absent information, descriptions and illustrations of the species from the literature were consulted (Hilty & Brown 1986, Meyer de Schauensee & Phelps 1978, Schuchmann 1999,

Ridgely & Greenfield 2001). The same procedure was carried out for information on age (sexual maturity, involving two categories: adult or immature). If the age was not indicated on the label, immaturity was identified by the presence of grooves on the maxilla's rhamphotheca (Ortiz-Crespo 1972), reddish brown fringes on the feather borders, and duller overall coloration in the case of dimorphic species.

Only data from adult specimens were included for the statistic analysis as well as the phylogenetic reconstruction .

1.3 Morphometric Data

In order to assess geographical variation in the morphometrics of the studied taxa, several external structures were measured. All measurements were taken directly from the specimens (on the left side), with a digital calliper to the nearest 0.1 mm. The measured morphological structures are described in the following list:

- bill-length: taken from the proximal end of the operculum to the tip of the maxilla;
- length of the innermost rectrix (R1): taken from the left innermost tail feather from the pygostyle insertion to its tip;
- length of the outermost rectrix or tail-length (R5): taken from the left outermost rectrix from the pygostyle insertion to its tip. This feather is the longest in the tail, so represents total tail-length;
- tail fork-depth: calculated as the difference between values of R5 and R1 (R5 – R1);
- wing-length: from the left wing 'shoulder' to the tip of the first primary without flattening.

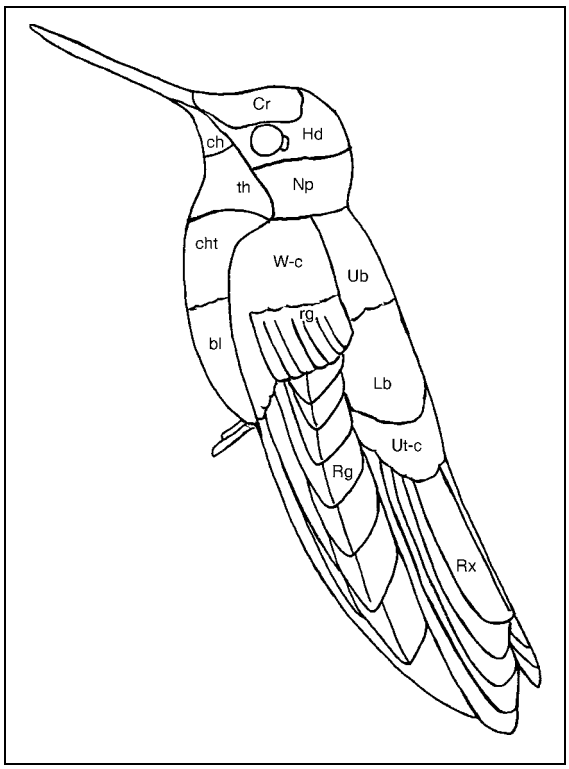


Figure 1.1. Scheme of the body parts described for the coloration pattern analysis. Cr: crown; Hd: head; Np: nape; Ub: upper back; Lb: lower back; Ut-c: upper tail-coverts; Rx: rectrices; ch: chin; th: throat; cht: chest; bl: belly; W-c: wing-coverts; Rg: primary remiges; rg: secondary remiges.

1.4 Description of the Coloration Patterns

Body topology as shown in Fig. 1.1 was used for the description of the coloration pattern. For the analysis, the following plumage features were described:

-Crown (Cr): colour and shape of the metallic coloured structure(s) on the head;

-Head (Hd): colour pattern of the area not occupied by the crown, if present.

-Nape (Np): colour of the area between the head and the upper back;

-Upper back (Ub): colour of the more anterior section of the upperparts;

-Lower back (Lb): medial section of the upperparts, between the upper back and the upper tail-coverts;

-Upper tail-coverts (Ut-c): pattern of the coverts and presence of tipping, borders, or discs on the feathers covering the tail;

-Rectrices (Rx): colour pattern of the tail feathers, described separately if they presented differentiated coloration (e.g., innermost or outermost rectrix different);

-Chin (ch): colour pattern of the more anterior section of the underparts, immediately behind the mandible;

-Throat (th): colour pattern of the area between the chin and the chest and presence of special structures (metallic patches, bands, collars);

-Chest and Breast (cht): colour pattern of the medial section of the underparts, usually showing the same pattern. Both body parts were described separately only if differences were found;

-Belly (bl): coloration of the most posterior section of the underparts;

-Under tail-coverts (ut-c): pattern of the coverts and presence of tipping, borders, or discs on the feathers under the tail;

-Wing-coverts (W-c): colour of the feathers covering the remiges;

-Remiges (Rg, rg): colour of the wing feathers, especially differences between primaries and secondaries.

Colours were determined in daylight when possible in order to maintain similar light conditions, thus avoiding influence of non-white light, and standardised using the Smithe (1975) colour lists. Descriptions of coloration were made separately for each sex within each subpopulation or pool (see Section 3 for pools explanation), and later these pools were grouped according to the degree of similarity in the coloration patterns observed.

Changes considered as relevant were principally those on the colour value (i.e., the value determined from the standardised list, here after called ‘base colour’). The colour hue was organolepthically determined and recorded. It has recently been proven that human colour perception is virtually indistinguishable from physical colour measurements made with spectrometers (Romney & Indow 2002). Therefore being confident in the methods of colour identification and differentiation chosen, changes in conspicuous patterns as well as the presence of discrete coloured structures, were also considered. Coloration descriptions were later processed and coded for the phylogenetic analysis matrix (see Section 4).

2. Mapping

Geographic coordinates for the localities taken from the skin labels were obtained or calculated using different sources:

- ornithological gazetteers of Venezuela (Paynter 1982), Colombia (Paynter 1997), Ecuador (Paynter 1993), Peru (Stephens & Traylor 1983), Bolivia (Paynter 1992), Chile (Paynter 1988), and Argentina (Paynter 1995);
- geographic gazetteer publications available on the internet: Alexandria Digital Library Project**,** version 2.2–08/27/2002, (http:// www.alexandria.ucsb.edu/gazetteer);
- other ornithological-biogeographic literature source (Sánchez Osés 1995); and
- cartographic material of South America: (Healey 1996, 1999a, b; ITMB 2000).

The data for each taxon was compiled in a Microsoft Access 2000 database, and loaded into a geographic information system (ArcView GIS 3.2). Coordinates were plotted on to a processed base map with digitalised altitudinal data of South America produced by the Active Archive Center of the United States, Geological Survey – USGS – (http://edcdaac.usgs.gov/gtopo30/gtopo30. html). The country outlines were complemented with world map shapes contained in ArcView (update year 2002).

3. Geographic Pools and Statistical Analysis

3.1 Construction of the Geographic Pools

Geographic pools were determined on the basis of localities. Pool borders and extensions were defined by geographical barriers like deep valleys, wide rivers, or high mountain ranges that were able to separate populations, in this way reproducing possible natural populations and scenarios, according to the methodology employed by several authors in geographic variation analysis in Andean birds (Bleiweiss 1985, 1988; Graves 1980, 1985; Vuilleumier 1968).

The pools were numbered for the statistical tests and named to resemble the geographical areas where they are located.

3.2 Statistical Analysis and Plotting

The morphometric data were grouped into categories corresponding to the geographic pool constructed and for each pool descriptive statistics were calculated. Sexual differences in morphometric characters within pools, and differences between pools for the separate sexes were tested. A multivariate comparison was carried out by an Analysis of Variance (ANOVA), and the *post hoc* Tuckey-test for unequal samples, with $\alpha<0.05$. The minimum sample size allowed per pool was two ($N\geq2$), due to the paucity of data for some taxa. The Tuckey-test was preferred to the commonly used Mann-Whitney-test (U-test) multiple comparison because the application of the latter in non-paired crossing comparison (more than two groups) is a source of type II error, i.e., the alternative hypothesis (the variances are different) is wrongly rejected (Zar 1984). The probability of making this error becomes higher the more numerous the groups to be compared are.

Morphological sexual dimorphism was tested within the pools and with a non-parametric Mann-Whitney-test (U-test, with $\alpha<0.05$). All statistical tests were carried out with SPSS 10.07.7 (June 2000) for Windows.

Means of each morphological character (± standard error) were plotted against the north-to-south ordered pools with SPSS 10.07.7 (June 2000) for Windows.

4. Phylogenetic Analysis

In order to reconstruct the phylogenetic relationships between the studied taxa, a maximum parsimony analysis was performed. For this purpose, a matrix was created that included the nominate form of each species, with their plumage coloration pattern and bill shape as characters (see Tab. 2 in the Appendix). Based on the DNA-hybridisation phylogenetic reconstructions of Trochilidae by Bleiweiss *et al.* (1994, 1997), *Heliodoxa leadbeateri* was selected as first outgroup. *Sephanoides sephaniodes* was employed as complementary outgroup based on its close relationships to the genus *Heliodoxa* (Renner 2000).

4.1 Matrix of Characters

One of the goals of this study was to determine the phylogenetic relationships within the genus *Coeligena* and to clarify its relationship to the genera *Pterophanes*, *Ensifera*, and *Patagona*. For this, only the nominate form (nominate subspecies) of each species were selected, in order to avoid unnecessary polyphyly. Polyphyly originates in the very similar coloration pattern of subspecies within a species.

The choice of taxa for the matix (presented in the section Taxonomic Conclusions) was based on the results of my taxomomic revision. The character matrix for the phylogenetic reconstruction was constructed using the colour patterns described for each body part (Fig. 1.1) and simplified for the character coding. The different base colours and hues were coded for each body part as two independent multistate characters. In order to avoid redundant and non-informative characters, the base colours, as well as the hues, were summarised to more simple categories (e.g., Parrot Green 260: base colour = green, hue = yellowish). The absence and presence of coloured structures were coded as 0 or 1 respectively, and their relative extensions and other characteristics as multistate characters (e.g., tail pattern: inner rectrix different = 0, outer rectirx different = 1, tail feathers tipped = 2, etc., see Appendix).

The high variation in plumage colour within *Coeligena* can lead to equivocal conclusions about relationships at higher taxonomical levels, as is the case in many trochilids (Hilty & Brown 1986). For this reason, external bill morphology (compression, depression, and curvature) was employed as a non-coloration morphological character in order to assess deeper phylogenetic relationships between the studied taxa.

Body measurements were excluded from the matrix, as they are quantitative variables. Their inclusion would require transformation of all the qualitative characters to continuous variables through a step-matrix-gap-weighting coding and the analysis would have to be performed using a modified Thiele approach as parsimony method (Wiens 2001).

The matrix includes characters of both sexes separately coded. The presence and degree of sexual dimorphism was not included as an extra character, thus avoiding indirect weighting of any character.

4.2 Cladogram construction

For the phylogenetic analysis, the characters were not weighted and not polarised. The analysis, using the program PAUP* 4.0b.10 (Swofford 2001), started with a heuristic search for all possible trees, with the branch-swapping command set to ‘nearest-neighbour interchange’ (swap = nni) and a randomised addition sequence (addseq = random). The generated trees were rooted with the outgroups and later a strict consensus tree was calculated. The groups occurring on less than 50% of the trees were retained if they were compatible with the groups already present on the tree (LE50 = yes).

To solve conflicts between characters (homoplasy) on the consensus tree obtained, an analytical successive approximations approach to character weighting was applied (Farris

1969), using the rescaled consistency index in each iteration (after Farris 1988) until the final tree topology showed no changes.

4.3 Data support for the phylogenetic reconstruction and interpretation

To verify how the frequency of characters in the nodes supported each branch, a jackknife analysis was carried out based on a heuristic search with the parameters mentioned above, keeping those groups with frequencies lower than 50% (keepall = yes) as long as they were compatible with all the groups already included in the consensus.

The consensus trees and the list of apomorphies were used later, together with the distribution maps, for the interpretation of speciation patterns.

5. Biogeographic Analysis

For the historical biogeographic analysis of the taxa studied, a Brook's Parsimony Analysis (BPA) was performed, which is based on the assumption that species are ontological individuals, therefore they, and the speciation events that form them, are evolutionarily independent variables (Brooks 2001). This analytical method has been developed very recently, and only has been used in few taxa (see Brooks & McLemman 1991, Brooks 2001 for details). For this reason, the theoretical framework and assumptions are presented before the methodological description of the analysis itself.

5.1 Theoretical framework

Monophyletic clades yielded by phylogenetic reconstruction, with members sharing a similar geographical distribution, can be used for biogeographic analysis, in an approach to a general pattern explaining the historical distribution of *Coeligena*, additionally allowing us to infer such patterns for other closely related taxa. The use of monophyletic species clades of the same genus has been shown to be useful for the determination of historical relationships to other genera (Prum 1988).

The null hypothesis for this kind of analysis states that each area has a single history with respect to all the species that inhabit it, thus similar distribution patterns should be the result of similar vicariance processes, unless special circumstances are specified.

The BPA analysis consists of two consecutive analyses. The primary analysis allows us to find a general pattern in the form of an area cladogram, and possibly to discover if there are

homoplasies acting as falsifiers of the null hypothesis which could be interpreted *a posteriori*. The secondary analysis provides the *a posteriori* interpretation of the homoplasies, considering them as products of a process other than vicariance (i.e., range expansion following speciation, speciation by dispersal, or non-response to a vicariant event). The results of the secondary analysis function as the basis for the reconstruction of the biogeographic and speciation scenarios.

5.2 First step: the choice of areas

For the BPA analysis, the total range of the genera *Coeligena*, *Pterophanes*, and *Ensifera* was divided into areas that corresponding to geological units, according to their formation during the uplift of the Andes (after Simpson 1975). *Patagona* was excluded, not being part of the monophyletic group. These areas were ordered from north to south and coded for their identification on the matrix and area cladograms. In the section Biogeography a map showing the areas here mentioned is shown. The chosen areas are:

A1: Sierra Nevada de Santa Marta; A2: Eastern Cordillera of Colombia (including Cordillera de Perija, Merida Andes, and Cordillera de la Costa of Venezuela); A3: Central Andes of Colombia and East Andes of Ecuador; A4: Western Cordillera of Colombia and Ecuador; A5: Cordillera Occidental of Peru; A6: Cordillera Oriental of Peru; A7: Altiplano of Bolivia.

5.3 Second step: construction of the matrices

Three monophyletic clades, products of the phylogenetic reconstruction, were selected for the elaboration of the matrix. An identification number was assigned to each node and terminal taxa (study species) on each clade topology. Later, the terminal taxa were substituted by the areas they occupy, the nodes representing the ancestral taxon or form of the extant species. Because they represent hypothetical taxa, they are only identified with the number assigned at the beginning of analysis.

Each area constitutes an operational phylogenetic unit (rows of the matrix) and each numbered node and species constitutes the characters (columns of the matrix). The matrix is filled with data on presence-absence of every taxa in each area, forming a binary matrix, 0 = absent; 1 = present (tables and figures are shown in the Biogeographic Analysis section). If a whole clade is absent in an area, all its taxa are considered missing (signified with '?'), but if at least one member of one clade is present in the area, the remaining members are considered absent (code 0).

From the results of the primary BPA analysis, areas that exhibited homoplasy on the area cladogram were subdivided, in order to find which of those subdivisions explains the homoplasies on the tree branches. A new matrix with these areas subdivisions, and with the same methodology described as above, was elaborated and the same PAUP* commands were executed (see below).

5.4 Third step: BPA Analysis

The primary and secondary BPA analyses were performed with PAUP* 4.0b.10 (Swofford 2001), using a heuristic search with the branch swapping command 'subtree pruning and regrafting' (swap = tbr); addseq = random; and nrep = 1000, and for each case a Majority Rule consensus (semistrict) was calculated.

The primary BPA analysis produced an area cladograma that depicts the general biogeographical pattern and the possible incongruences in taxa and nodes distribution on the tree topology caused by events and process other than vicariance.

The secondary BPA analysis produced another area cladogram similar to that obtained in the first analysis, but with areal subdivisions that explain the speciation events caused by non-vicariant processes (incongruences on the first tree).

The biogeographic conclusions, as well the speciation scenario for *Coeligena* species and for *Pterophanes*, *Ensifera*, and *Patagona*, are based on the results of the secondary BPA analysis. This scenario was used to test the South-to-North Speciation Hypothesis proposed by Doan (2003) to explain high-Andean biota speciation patterns.

Species Accounts: Discussion on the Taxomomy and the Geographic Variation of the Morphometric and Coloration Characters

1. Genus *Coeligena* Lesson, 1832

The genus *Coeligena* represents a heterogeneous group, from the point of view of plumage coloration. Species have been placed into different genera by several authors, based on the group's very characteristic highly polymorphism (see below). Despite the very high plumage differentiation, *Coeligena* species diagnostic characters consist of external structures that confer a similar general aspect among the species.

Coeligena species can be recognised by the long, straight, slightly upward-curved bill, twice as long as the head; the head plumage extends on the maxilla (upper mandible) up to 1/6 or 1/4 its length, partially covering the nostrils. The wing tips reach the tail tip, in some cases surpassing it. The upper tarsus is generally moderately feathered; the tail fork is more or less pronounced, being less than 1/3 of the tail-length; tail-length reaches *c*. 2/3 to 3/4 of the wing-length. The species are sexually dimorphic in both plumage coloration and size; or only in size (Hartert 1900, Elliot 1878).

The genus *Coeligena* described by Lesson (1832-1833?: there is uncertainty in the publication year, see Perterson 2002) included the species *Ornismya Cœligena* (type species = *Coeligena coeligena*) and *O. Rivolii* (=*Eugenes fulgens*), both from Mexico, *O. mesoleuca* (=*Heliomaster squamosus*) from Brasil and *Ornismya superba* (=*Heliomaster longirostris*) from Trinidad. The genus type locality was later corrected to 'the vicinity of Caracas, Venezuela' (see *Coeligena coeligena* for details on the history of taxonomy changes).

The distribution of the taxon is exclusively Andean and relatively continuous, extendind across the adjacent mountain ranges of the Cordillera de la Costa, in north-east Venezuela; the Sierra de Perija, in the northern border of Venezuela and Colombia, and in the Sierra Nevada de Santa Marta, northern Colombia (Fig. 2.1). The range extends along the Andean eastern slopes from western Venezuela to central Bolivia, and parallel on the Central and West Andes of Colombia and the western slopes of the Ecuadorian Andean.

The following taxa are currently considered as synonyms of *Coeligena* Lesson, 1832 (Peters 1945):

- *Helianthea* Gould 1848, type: *Ornismya helianthea* Lesson, 1838, type locality 'Santa Fe de Bogotá'.

- *Bourcieria* ***Bonaparte 1850***, type: *Ornismia torquata* Boissonneau, 1840, type locality unknown.

- *Helianthea γ Hypocrysia* Reichenbach 1853, type: *Ornismia Bonapartei* Boissonneau, 1840, type locality 'Santa Fe de Bogotá'.

- *Bourcieria α Conradina* Reichenbach 1853, type: *Trochilus Conradi* Bourcier, 1847, type locality 'vicinity of Caracas'.

- *Bourcieria β Homophania* Reichenbach 1853, type: *Trochilus Prunellei* Bourcier, 1843, type locality 'surroundings of Facativa, Colombia'.

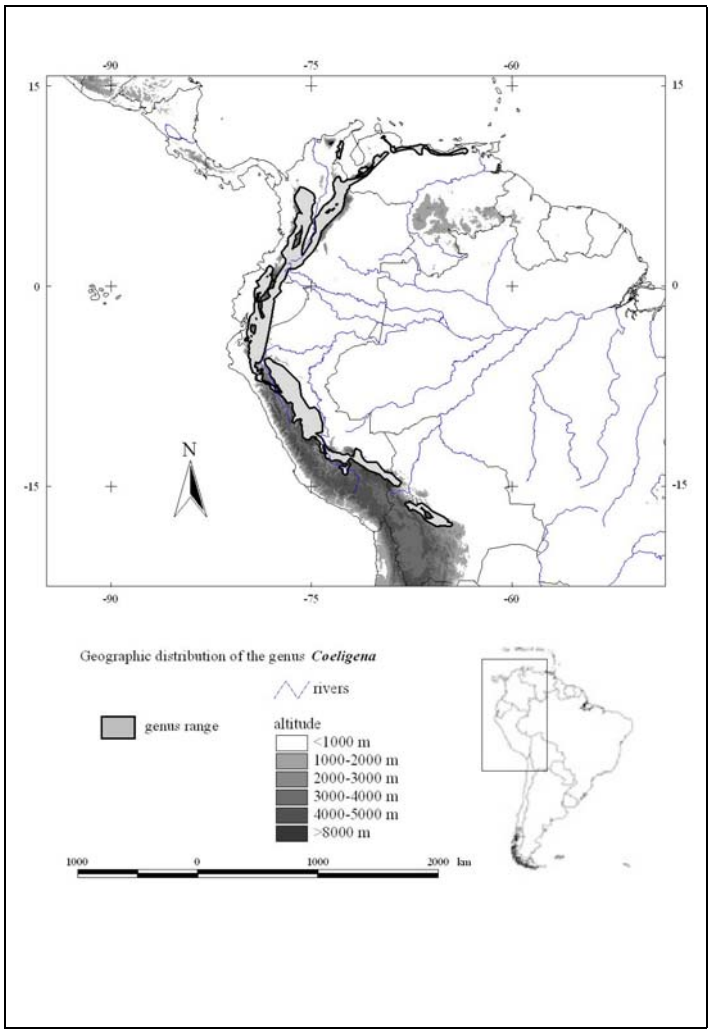


Figure2.1. Geographic distribution of *Coeligena* Lesson, 1832. The polygon represents the geographic range of the genus.

- *Bourcieria γ Lampropygia* Reichenbach 1853, type: *Trochilus Wilsoni* Bourcier, 1846, type locality 'Las Juntas, Colombia'.

- *Diphlogena* Gould 1854, type: *Helianthea Iris* Gould, 1853, type locality ‘eastern slope of the Andes’.

- *Calligenia* Mulsant 1875, type: *Trochilus Lutetiae* Delattre & Bourcier, 1846, type locality ‘Puracé Volcano, Colombia’.

- *Leucuria* Bangs 1898, type: *Leucuria phalerata* Bangs 1898, type locality ‘Macotama, Colombia’ (error: San Miguel, Cerro Caracas, Colombia).

- *Lampropygia* (*Pseudohomophania*) Simon 1921, type: *Trochilus Wilsoni* Bourcier, 1846, type locality ‘Las Juntas, Colombia’.

- *Lampropygia* (*Pseudocæligena*) Simon 1921, type: *Trochilus violifer* Gould, 1846, type locality ‘Bolivia’.

The most modern taxonomy includes 12 species and 34 subspecies within the genus *Coeligena*, which will be thoroughly treated in the following sections, presented in a north-south arrangement.

1.1 *Coeligena coeligena* (Lesson, 1832)

1.1.1 Geographic distribution and taxonomy

The range of *Coeligena coeligena* extends from the Cordillera de la Costa, in central-northern Venezuela, to the south-eastern Bolivian Andes slopes, at altitudes between 1200 m and 2600 m. The species range seems to be interrupted by the high Andes of Mérida, in western Venezuela (Sánchez Osés 1995).

Seven subspecies are currently recognised: the nominate race (*C. c. coeligena*), that extends from the Cordilleras de la Costa and del Interior, in central-northern Venezuela, to the westernmost branch of the Cordillera de la Costa (Lara). *C. c. columbiana* with a large range, occurs from the Venezuelan Andes to the East Andes in central Colombian. The range seems to be interrupted by the high Andes of Merida, in western Venezuela. *C. c. zuloagae* is only known from a single specimen, collected in Curimagua, Sierra de San Luis, in north-western Venezuela. *C. c. zuliana* is restricted to the Cordillera de Perija, on the northernmost Venezuelan-Colombian border. The race *C. c. ferruginea* extends on the Central and West Andes of Colombia. *C. c. obscura* extends on both Andes slopes, from south-western Colombia to southern Peru, near the border with Bolivia. *C. c. boliviana*, the southernmost subspecies, is restricted to the western slope of the Andes of northern Bolivia.

The classification of this taxon dates back to Lesson 1832) with the description of *Ornismya coeligena* from a specimen from 'Mexico' placed in the 'Mexican Clemences' tribe, formally *Coeligena* Lesson, 1832. Bonaparte (1850) later renamed the taxon as *Caeligena typica* Bonaparte as an indicator of the genus type species. Reichenbach (1853) expanded the geographic range by adding New Granada (former name of for Colombia and Ecuador) and Venezuela to the known range. Gould (1861) proposed including the species into *Lampropygia* Reichenbach, 1853; based on the dull plumage coloration, changed the name to *Lampropygia cœligena* (Lesson, 1832); excluded Mexico from the range, and also described a new congeneric species, *Lampropygia boliviana* from Bolivia. Elliot (1876) assigned 'Venezuela' as the range of *Lampropygia cœligena* (Lesson, 1832), and described the species *Lampropygia columbiana* as typical of the vicinity of Bogota and Ecuador. Later, Elliot (1878), based on morphological characters and plumage coloration patterns, grouped the three species mentioned above into the genus *Bourcieria* Bonaparte, 1850, the new names being *Bourcieria cœligena* (Lesson, 1832), *Bourcieria boliviana* (Gould, 1861), and *Bourcieria columbiana* (Elliot, 1876).

Hartert (1900) maintained Elliot's species group classification but preferred to place them within the genus *Helianthea* Gould, 1848, presenting *Helianthea coeligena* (Lesson, 1832) with the subspecies *H. coeligena (typica)* (Lesson, 1832) from the Venezuelan coastal range, *H. c. columbiana* (Elliot, 1878) from the Colombian and Ecuadorian Andes, and *H. c. boliviana* (Gould, 1861) from the Bolivian Andes. Berlepsch & Stolzmann (1902) described a specimen from 'Garita del Sol' in central Peru as *Lampropygia columbiana obscura*, following the genera rearrangements proposed even before Elliot (1878) and Hartert (1900).

Chapman (1917) made use of Hartert's (1900) classification scheme describing a new subspecies *Helianthea cœligena ferruginea*, with type locality 'San Antonio, above Cali, West Andes of Colombia'. As part of this back and forth in the species taxonomy, Simon (1921) made his contribution in reviving the old classification from before 1876 (genus *Lampropygia* Reinchenbach, 1853) and complicating the taxonomy of the group by adding subgeneric divisions. One of them, *Pseudocœligena*, included four subspecies of *Lampropygia cœligena* (Lesson, 1832): *L. coeligena* (*typica*), *L. c. columbiana* (Elliot, 1876), *L. c. ferruginea* (Chapman, 1917) and *L. c. boliviana* (Gould, 1861); this latter included (*sic*) *L. columbiana obscura* Berlepsch & Stoltzmann, 1902.

Peters (1945) included numerous species in the genus *Coeligena* Lesson, 1832, and listed all the taxa above-mentioned as subspecies of *Coeligena coeligena* Lesson, 1832, having this name priority for being the first described species of the group. Phelps & Phelps (1953) described a new subspecies from the Venezuelan Perija Mountains, *Coeligena coeligena zuliana*, with type locality 'Cerro Pejochaima, upper Rio Negro, Sierra de Perijá, Zulia, Venezuela'. Later, Phelps & Phelps (1959) described *Coeligena coeligena zuloagae*, with type locality 'Curimagua, Sierra de San Luis, Estado Falcón, Venezuela', only known from the holotype, and it is probably necessary to revise the validity of this taxon; nevertheless, in recent publications it has been recognised as a valid race (Fjeldså & Krabbe 1990, Schuchmann 1999).

1.1.2 Diagnosis

Coeligena coeligena presents a homogeneous and relatively uniform sexually monomorphic plumage coloration. In males the bill is long, straight and black; head and upperparts bronzy Maroon 31; lower back with glittering discs Lime Green 159; upper tail-coverts Maroon 31. The chin, throat and upper chest are white-spotted Cinnamon-Brown 33; rest of underparts greyish Cinnamon-Brown 33 fringed greenish; under tail-coverts bronzy Olive-Green 48 with

borders Raw Sienna 136. The tail is forked bronzy Greenish Olive 49. Females are similar, with wings and tail shorter and less deeply forked. The immatures are similar to the adults.

1.1.3 Geographic variation analysis

A total of 230 specimens *Coeligena coeligena* (119 males, 97 females and 14 immatures) was examined. The localities were grouped into 27 geographic pools (see Fig. 2.1.1). Pools and the descriptions of the corresponding areas are ordered from north to south:

1. Caripe: located in El Guácharo National Park, Anzoátegui on the Cordillera Oriental, northeastern Venezuela, above 1500 m a.s.l.

2. Golfo Triste: located in the Cordillera del Interior, in central-northern Venezuela, between 1000 and 1100 m.

3. Avila: located in the Avila National Park, in the vicinity of Caracas, on the northern slope of the Cordillera de la Costa, between 900 and 1900 m.

4. Aragua: located between Maracay (Aragua) and Caracas, on the northern slope of the Cordillera de la Costa, between 1200 and 2100 m.

5. Valencia: located on the slopes of Cerro Cumbre de Valencia, southwest of the Lake of Valencia, Carabobo, at 1700 m.

6. Yaracuy: located in the Sierra de Aroa (Yaracuy), northernmost extension of the East Andes, in northwestern Venezuela, between 1300 and 1700 m.

7. Lara: located on the mountain ranges south of Barquisimeto, Lara, northwestern Venezuela, between 1400 and 1900 m.

8. Perija: located on the Sierra de Perija, on the northern border of Venezuela and Colombia, between 1700 and 2300 m.

9. Tachira: located on the border between Venezuela and Colombia, north of Paramo Tama, between 1500 and 2200 m.

10. Santander: located from the vicinity of Cúcuta, Norte de Santander, to Bucaramanga, Santander, in the Central Andes of Colombia, between 1000 and 1980 a.s.l.

11. Antioquia: located in the surroundings of Medellin, Antioquia, in the West Andes of Colombia, between 700 and 2200 m.

12. Moscopan: located south of Medellin, in the West Andes of Colombia, between 1700 and 2000 m.

13. Quindio1: located north of Quidio, on the western slopes of the West Andes of Colombia, between 2100 and 2300 m.

14. Quindio2: located north of Tolima, on the eastern slopes of the West Andes of Colombia, between 2100 and 2700 m.

15. Cundinamarca: located in the vicinity of Bogota, Colombia, between 1500 and 2600 m.

16. Gamboa: located north-west of Cali, on the western slope of the West Andes of Colombia, between 2100 and 2300 m.

17. Popayan: located in Munchique National Park, west of Popayan, Colombia, between 1800 and 2700 m.

18. Huila: located near San Agustin, on the western slopes of the Andes of southern Colombia, between 900 and 2300 m.

19. Baeza: located near Baeza, east of Quito, on the eastern slopes of the north Ecuadorian Andes, between 1500 and 2500 m.

20. Tungurahua: located in the vicinity of Tungurahua, on the eastern slopes of the Andes of central Ecuador, between 1100 and 2000 m.

21. Condor: located on the Cordillera del Condor, southern Ecuadorian Andes, near the border with Peru, between 1500 and 1800 m.

22. Amazonas: located south of the confluence of the River Chinchipe and the River Marañon, northern Peru, between 1700 and 2000 m.

23. Utcubamba: located along the western slope of the central Peruvian Andes, between 1300 and 2500 m.

24. Vilcabamba: located in the Cordillera de Vilcabamba, near Cuzco, southern Peru, between 1500 and 2100 m.

25. San Pedro: located in the Pantiacolla mountain chain, between Manu National Park and Tambopata-Candamo Nature Reserve, between 1000 and 1500 m.

26. La Paz: located near the border with Bolivia, south of the Tambopata-Candamo Nature Reserve, southern Peru, at 2000 m.

27. Locotal: located in the Bolivian Yungas, east of Cochabamba, north-western Bolivia, at 1800 m.

1.1.3.1 Morphometric variation

Males of *Coeligena coeligena* have longer wings and longer and more deeply forked tails than females ($p>0.01$), whereas no significant difference was found in the bill-length between sexes. The more striking geographic variation was detected in the bill-length of males and females of the eastern and central-northern Venezuelan pools: Caripe, Golfo Triste to Lara (pools 1-7), having significantly longer bills ($p<0.01$; males 37.3-36.0 mm, females 38.3-36.6 mm) than in the adjacent Tachira (pool 9, males 35.0±0.53 mm, females 33.8±1.34 mm) and Perija (pool 8, with shortest bills in the species range, males 31.9±0.14 mm, females 33.0±1.13 mm). A clear clinal increase in the bill-length can be observed (Fig. 2.1.3) from the pools in western Venezuela southwards; the lowest values were found in northern Colombia and western

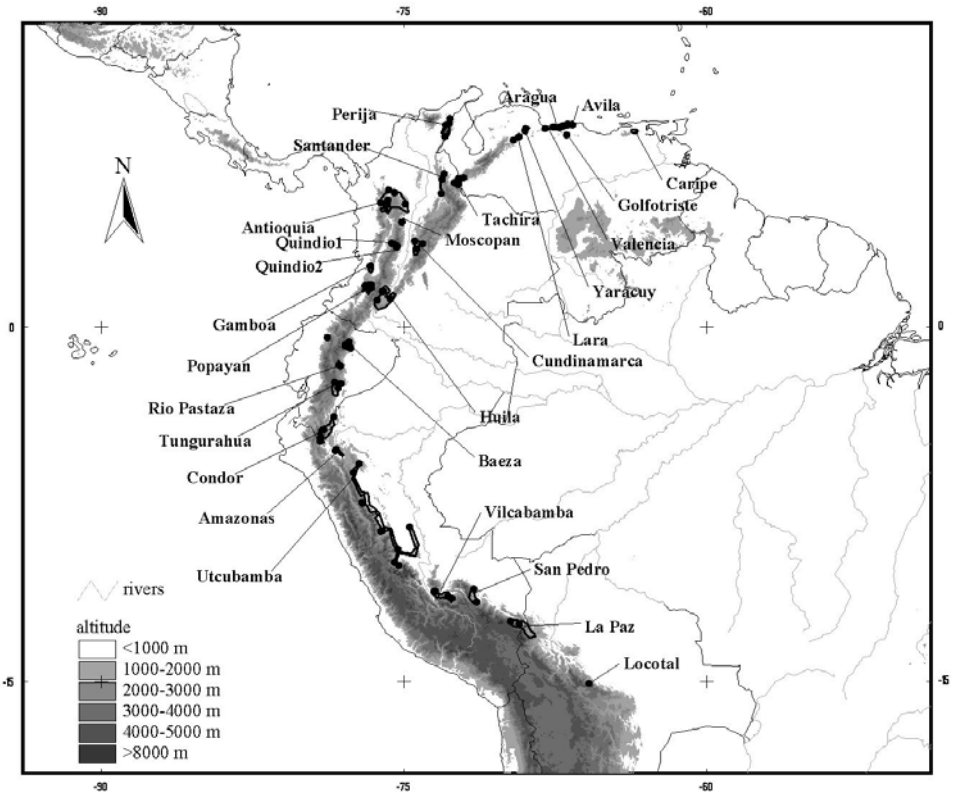


Figure 2.1.1. Geographic distribution of *Coeligena coeligena.* Polygons represent the geographic pools, dots the localities.

Venezuela (males c. 33.9 mm, females c. 33.9), intermediate values in southern Colombia and Ecuador (males c. 34.5 mm, females c. 34.6 mm), and the highest values in the pool San Pedro, southern Peru (males 37.8±1.05 mm, females 36.0±0.50 mm). Males in the Caripe, Avila and Golfo Triste pools (1-3) have the longest wings (76.0-75.2 mm). In the pools south of those mentioned above a slight clinal increase in the wing-length was detected, not as marked as in bill-length (Tab. 2.1.1). No significant variation was detected in tail morphometry (Fig. 2.1.4 for details).

1.1.3.2 Plumage variation

Diagnostically, this species presents a very constant coloration pattern throughout its whole range. Nevertheless, some distinctions can be made, based on the change in hues and base colour on several bodyparts. Specimens from the pools Caripe, Golfo Triste, Avila, Aragua and Valencia (1-5) have head and upperparts between reddish Brick Red 132A and Maroon 31; lower back feathers with reddish Brick Red 132, base and tips glittering Emerald Green 163, forming discs; upper tail-coverts bronzy Mars Brown 223A, less reddish in Avila specimens (pool 3). The chin and throat are white with many reddish Dark Brownish Olive

129 spots; underparts Grayish Olive 43 tipped Cinnamon 39; under tail-coverts Olive-Green 46 bordered Tawny 38. Rectrices are bronzy Olive Green 46. Specimens from Yaracuy (pool 6) are very similar to the previous pools, but less reddish.

Birds from the Perija pool show poor differentiation from the pattern seen in central-northern Venezuela, the overall brown coloration being rather yellowish. The upperparts are greener overall, having a mixture of Raw Sienna 136 and Dark Green 262; lower back less green. No other relevant coloration differences were detected.

Specimens from Lara, Tachira, Santander and Cundinamarca (pools 7, 9, 10 and 15) are practically identical, with the head feathers reddish Raw Umber 23 tipped Fuscous 21, more reddish in some skins from Cundinamarca (pool 15). The upperparts are Raw Umber 23 with yellowish Parrot Green 160 discs; lower back greener. The upper tail-coverts are brownish Olive-Green 46, bordered reddish brown (Raw Umber 23), but in Cundinamarca skins golden Russet 34 with paler border. The chin and throat are as described above; underparts more greyish; under tail-coverts Fuscous 21 bordered Cinnamon 123A. Tail Olive-Green 46 slightly tipped with very pale reddish brown.

The pools in the West Andes of Colombia, from Antioquia to Popayan (pools 11-14, 16, 17) exhibit a predominantly greenish-olive coloration. The head is bronzy Parrot Green 260; upperparts feathers with base rusted Ferruginous 41 bordered glittering Apple Green 61; lower back greener with turquoise fringes; upper tail-coverts bronzy Ferruginous 41 with paler borders. The chin and throat have elongated elliptic Dark Brownish Olive 129 spots bordered Cinnamon 39 on white background, becoming pale Cinnamon 39 laterally; underparts feathers with blackish Green-Olive 46 base and Cinnamon 36 borders. The under tail-coverts are olive at the base with Tawny 38 borders; specimens from Popayan (pool 17) have very reduced or absent olive at the base; under tail-coverts in Gamboa specimens (pool 16) are completely Tawny 38; rectrices golden Dark Brownish Olive 129, sometimes tipped white.

Specimens from the pools in southern Colombia and Ecuador: Huila, Baeza, Tungurahua and Condor (pools 18-21), are very similar, differing from the northern specimens, in Tachira, Santander and Cundinamarca (9, 10, 15), in the greener head and upperparts coloration, the head being rather bronzy brownish Olive-Green 47. The upper tail-coverts in Huila skins (pool 18) are Dark Brownish Olive 129, occasionally bordered pale brown, whereas in those from Baeza, Tungurahua and Condor (19-21) the coverts were like those of Huila specimens

or dark Maroon 31 with paler brown borders. The remaining parts are similar to those in the northern pools.

Specimens within the Peruvian pools Amazonas, Utcubamba, Vilcabamba, San Pedro and La Paz (pools 22-26) present no important variation, the head being predominantly Dark Brownish Olive 129, mixed with brown near the bill; upperparts dark bronzy Maroon 31 mixed with dark Parrot Green 260; lower back greener (glittering Spectrum Green 62); upper tail-coverts dark Maroon 31. The chin and throat with reddish Dark Brownish Olive 129 spots forming parallel lines on pure white background; underparts Dark Brownish Olive 129 mixed with Chestnut 32 mottled white; under tail-coverts Dark Brownish Olive 129 bordered reddish Chestnut 32. Rectrices are bronzy Olive-Green 46 with tips reduced or absent.

Locotal is the southernmost pool in the *Coeligena coeligena* range (pool 27), being characterised by the absence of green on the head (bronzy Sepia 119). The upperparts are bronzy Sepia 119, fringed reddish and mixed with black; lower back greener (Spectrum Green 62) mixed with turquoise and brownish fringes; upper tail-coverts reddish dark Sepia 119. The chin and throat have small, very dark Dark Brownish Olive 129 spots on pure white background; underparts greyish Dark Brownish Olive 129 with some greenish fringes; under tail-coverts dark greyish Olive 30 with borders Raw Sienna 136. The rectrices are very dark Dark Brownish Olive 129 with tips extremely reduced or absent.

1.1.4 Discussion

Coeligena coeligena populations in north-central Venezuela (from Avila, pool 3 to Yaracuy, pool 6, included the pool Caripe, pool 1, in north-eastern Venezuela) form a distinguishable unit within the species, recognisable mainly through their longer bills and tails, the depth of the tail fork, and the extreme reddish hue on the upperparts and underparts, not found in any other pool (Fig. 2.1.3-4, Tab. 2.1.1). The reddish hue on the brown base coloration shows a reduction westwards, nevertheless the specimens from Yaracuy (pool 6) are still distinct from those of Lara (pool 7). This group of pools (Fig. 2.1.2) corresponds to *C. c. coeligena* (Lesson, 1832). For the westermost part of this region the subspecies *C. c. zuloagae* was described (Phelps & Phelps, Jr. 1959), but after observation of the holotype (the only known specimen) important differences with the specimens from north-central Venezuela could not be found, except for the less reddish hue on the lower back. Therefore, unless more evidence is found, I think this taxon should not be considered as valid, representing only a singular pattern variation of *C. c. coeligena*.

The other distinguishable unit is the Perija pool (pool 8), which is isolated in the Perija Mountain range, without apparent connection with the rest of the *C. coeligena* populations. The specimens from this pool are diagnosable by their short bills (Fig. 2.1.3) and the green coloration on the head, the rest of the body being reddish hued, similar to the Venezuelan pools. This pool corresponds to the taxon *C. c. zuliana* (Fig. 2.1.2).

From western Venezuela (Lara, pool 7) to southern Peru-northern Bolivia (La Paz, pool 26), on the western slopes of the Andes, through the East and Central Andes of Colombia, there are no large characters changes, but rather a substitution of colours. Based on this observation, it is possible to distinguish different northern and southern forms. The reddish brown coloration present on the head of specimens from western Venezuela and north-eastern Colombia (from Lara, pool 7 to Cundinamarca, pool 15), changed to olive in the Peruvian pools (from Amazonas to La Paz, 22-26), while the remaining upperparts stay very similar and the underparts in northern pools are more greyish. The other important change was found within the specimens from northern pools in the tail-coverts coloration, with the upper tail-coverts olive bordered pale brown (except for Cundinamarca, pool 15, where the coverts are completely reddish brown), and under tail-coverts fuscous brown bordered with reddish brown. Specimens from the southern pools show upper tail-coverts dark reddish brown, without differentiated borders, and under tail-coverts dark brownish bordered reddish brown. Individuals from the pool group Huila, Baeza, Tungurahua and Condor (pools 18-20) present a curious mixture of coloration patterns, sharing more similarities on the head, underparts and under tail-coverts with specimes of the group Tachira-Cundinamarca (pools 9, 10, 15), and showing a mixed coloration pattern on the upper tail-coverts, pool Huila (18) being the most similar to the northern pool group.

Specimens from the area between Lara and Condor pools (pools 7-21) are diagnosable by their much less reddish coloration (compared with north-central Venezuelan individuals), the absence of olive on the head, the upper tail-coverts olive bordered reddish brown, and the under tail-coverts completely brown. Ranges of two subspecies have been reported for this area: *C. c. columbiana* and *C. c. obscura*, but the specimens examined definitively belong to the race *C. c. columbiana*, presenting a clinal north-south darkening of the base coloration and increasing of the bill-length, with intermediate states in the pools from central and southern Ecuador (Fig. 2.1.3).

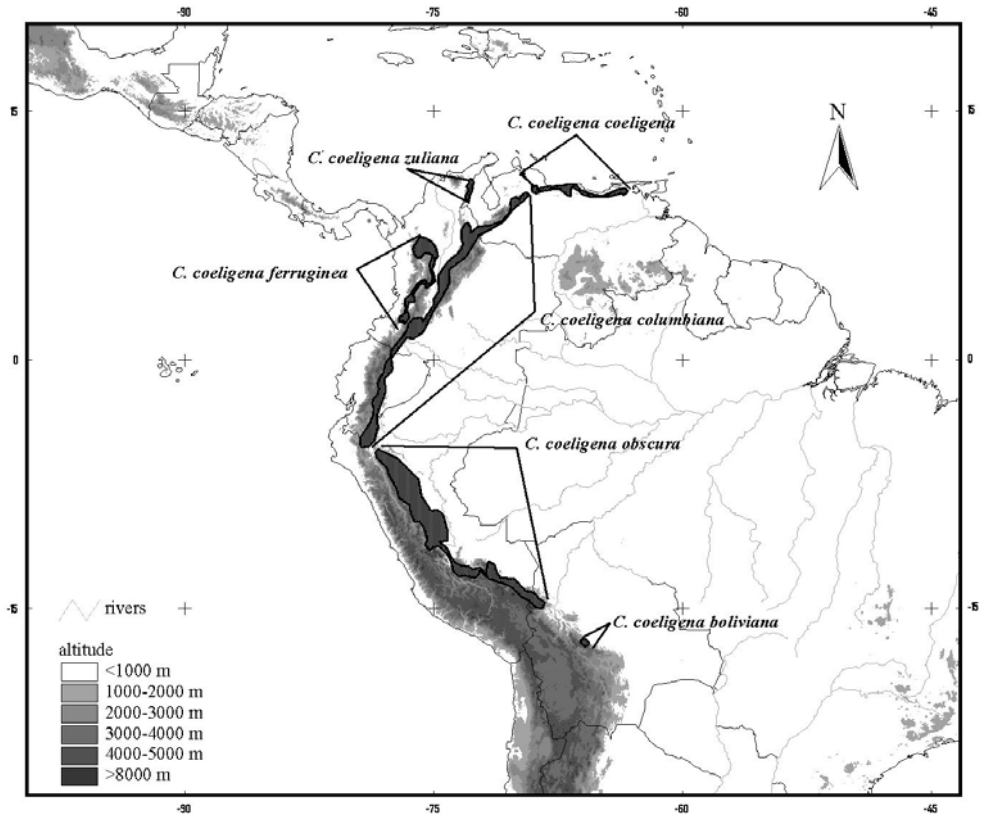


Figure 2.1.2. Map with the corrected distribution ranges of *C. coeligena* subspecies. The subspecies ranges are represented by filled polygons.

Individuals from the north Peruvian pool group are distinguishable by the darker olive head and overall darker bronzy brown coloration (including the upper tail-coverts), and the olive under tail-coverts bordered reddish pale brown. The taxon *C. c. obscura*, separated from the northern subspecies by the deep valley of the River Marañon (Fig. 2.1.2), corresponds to this distinct unit.

The pool Locotal represents by itself one distinct unit, recognisable by the pronounced dark-brown-fringed dark red coloration and the absence of olive on the upperparts. The underparts are very dark brownish olive, including the under tail-coverts, which are bordered reddish brown. The pool Locotal corresponds to the taxon *C. c. boliviana* (Gould, 1861) (Fig. 2.1.2).

The specimes from the pools in the West Andes of Colombia (Antioquia, Moscopan, Quindio1, Quindio2, Gamboa and Popayan, 11-14, 16, 17) form a distinguishable morphological unit, characterised by the overall yellowish rusty tonality of the coloration and the elongated, almost elliptical form of the dark-brownish olive spots on the chin and throat bordered reddish pale brown. Within this group, a north-south clinal reduction in the amount

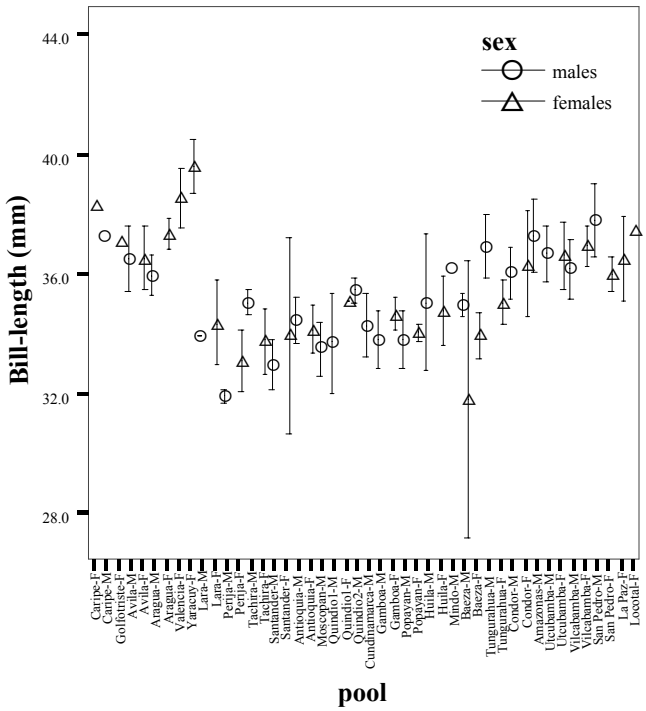
of olive at the base of the feathers on the under tail-coverts was detected , becoming reduced or absent. This group corresponds to the race *C. c. ferruginea* (Chapman, 1917) (Fig. 2.1.2).

Table 2.1.1. Descriptive statistics of the morphometric parameters of *C. coeligena*. Pools are geographically ordered, from north to south.

Morphometric parameters	Pools	Caripe	Golfo Triste	Avila	Aragua	Valencia	Yaracuy	Lara	Perija	Tachira	Santander	Antioquia	Moscopan	Quindio1	Quindio2	Cundinamarca	Gamboa	Popayan	Huila	Baeza	Tungurahua	Condor	Amazonas	Utcubamba	Vilcabamba	San Pedro	La Paz	Locotal
bill-length (mm)	males																											
	mean	37.3	-	36.5	36.0	-	-	33.9	31.9	35.0	32.9	35.0	33.5	33.0	35.4	34.3	33.8	33.8	35.0	35.0	36.9	36.0	37.3	36.7	36.2	37.8	-	-
	±S.D.	-	-	0.96	0.68	-	-	0	0.14	0.53	1.02	1.3	0.79	1.34	0.48	1.07	0.98	1.32	1.62	0.88	0.92	0.75	0.84	1.29	0.70	1.05	-	-
	Max.	-	-	37.4	36.6	-	-	33.9	32.0	35.8	34.4	36.5	34.4	34.0	36.0	35.6	34.9	35.7	36.2	36.6	38.0	36.8	37.9	38.5	36.7	38.9	-	-
	Min.	-	-	35.5	35.0	-	-	33.9	31.8	34.4	31.6	34.2	32.9	32.1	34.7	33.0	32.7	31.8	33.9	32.9	36.4	35.3	36.7	34.7	35.7	36.8	-	-
	N	1	-	3	4	-	-	2	2	7	6	3	3	2	5	4	4	7	2	21	3	3	2	8	2	3	-	-
	females																											
	mean	38.3	37.1	36.6	37.4	38.6	39.6	34.4	33.0	33.8	34.0	34.2	-	35.1	-	-	34.6	34.0	34.8	34.0	35.1	36.4	-	36.6	37.0	36.0	36.5	37.5
	±S.D.	-	-	1.18	0.35	1.11	0.75	1.60	1.13	1.34	2.33	1.20	-	0.00	-	-	0.56	0.38	1.30	1.04	0.72	1.76	-	1.39	0.66	0.50	1.19	-
	Max.	-	-	34.8	37.1	39.8	40.4	36.6	34.2	36.2	35.6	32.5	-	35.1	-	-	35.4	34.6	36.1	35.4	35.6	38.1	-	37.9	37.8	36.5	37.5	-
	Min.	-	-	38.1	37.6	37.1	38.9	32.8	31.5	32.5	32.3	36.1	-	35.1	-	-	34.1	33.6	32.6	32.5	34.0	34.6	-	33.9	36.3	35.5	35.2	-
	N	1	1	5	2	5	3	5	5	6	2	8	-	2	-	-	4	6	5	8	4	4	-	6	4	3	3	1
wing-length (mm)	males																											
	mean	75.8	-	74.8	75.2	-	-	71.8	74.1	68.8	73.0	72.8	69.8	70.7	71.7	72.9	73.4	73.8	74.5	73.2	75.3	73.8	75.0	74.6	73.2	74.0	-	-
	±S.D.	0.34	-	2.75	1.66	-	-	1.62	0.70	9.8	1.84	0.57	3.48	3.53	1.93	2.79	1.18	2.84	1.50	2.47	1.05	2.40	0.78	1.98	0.50	2.65	-	-
	Max.	76.0	-	77.5	76.9	-	-	72.9	74.6	76.6	75.7	73.2	73.0	73.2	73.9	75.8	74.9	77.2	76.1	77.2	76.4	75.4	75.6	77.3	73.5	76.8	-	-
	Min.	75.5	-	72.0	73.7	-	-	70.6	73.6	46.2	70.7	72.0	66.1	68.2	69.2	69.1	71.7	68.7	73.1	67.2	74.3	71.1	74.5	71.7	72.8	71.5	-	-
	N	2	-	3	4	-	-	2	2	8	6	4	3	2	6	4	6	7	3	21	3	3	2	9	2	3	-	-
	females																											
	mean	67.5	67.2	70.6	73.8	71.7	69.0	66.2	66.0	67.4	66.3	67.9	-	72.2	-	-	68.8	68.3	67.0	68.0	67.9	71.0	-	68.2	69.2	66.3	66.9	67.5
	±S.D.	-	0.64	2.33	4.45	1.95	0.87	1.56	2.72	2.89	0.00	1.77	-	1.13	-	-	2.28	2.18	2.02	1.54	1.06	4.30	-	1.40	0.80	0.98	0.42	3.25
	Max.	-	67.6	74.7	77.0	73.5	69.8	67.5	69.2	72.5	66.3	64.6	-	71.4	-	-	71.3	72.4	69.8	70.2	68.8	77.3	-	70.0	70.4	67.1	67.2	69.8
	Min.	-	66.7	69.1	70.7	68.7	68.1	63.8	63.2	65.0	66.3	70.3	-	73.0	-	-	66.3	65.9	64.9	65.6	66.4	67.8	-	66.5	68.6	65.2	66.6	65.2
	N	1	2	5	2	5	3	5	5	7	2	9	-	2	-	-	4	7	5	8	4	4	-	7	4	3	2	2

Table 2.1.1. (Continued) Descriptive statistics of the morphometric parameters of *C. coeligena*. Pools are geographically ordered, from north to south.

Morphometric parameters	Pools	Caripe	Golfo Triste	Avila	Aragua	Valencia	Yaracuy	Lara	Perija	Tachira	Santander	Antioquia	Moscopan	Quindio1	Quindio2	Cundinamarca	Gamboa	Popayan	Huila	Baeza	Tungurahua	Condor	Amazonas	Utcubamba	Vilcabamba	San Pedro	La Paz	Locotal
tail-length (mm)	males																											
	mean	49.5	-	48.8	49.8	-	-	48.0	51.0	49.9	48.4	46.6	48.2	45.4	46.6	48.4	46.4	48.2	47.0	46.2	50.0	48.2	49.3	49.8	48.2	46.4	-	-
	±S.D.	1.56	-	4.63	3.75	-	-	2.47	1.41	1.87	1.64	0.84	1.93	2.19	1.51	2.20	3.12	3.96	7.16	2.43	2.08	2.20	0.28	1.66	2.05	2.54	-	-
	Max.	50.6	-	51.9	53.7	-	-	49.8	52.0	52.9	50.9	47.6	49.8	47.0	49.3	50.1	49.6	52.5	51.9	50.3	52.4	50.4	49.5	53.2	49.6	49.2	-	-
	Min.	48.4	-	43.4	44.9	-	-	46.3	50.0	47.7	46.4	45.6	46.2	43.9	45.0	45.2	41.6	41.0	38.8	41.3	48.4	46.0	49.1	47.4	46.7	44.3	-	-
	N	2	-	3	4	-	-	2	2	8	6	4	3	2	6	4	5	7	3	21	3	3	2	9	2	3	-	-
	females																											
	mean	41.3	41-	45.2	49.0	43.1	43.7	43.2	41.9	41.6	42.8	42.5	-	43.6	-	-	41.5	42.3	41.8	39.4	40.5	44.4	-	42.1	42.0	43.0	40.0	47.4
	±S.D.	-	-	3.83	6.15	2.06	0.72	1.30	2.07	2.92	1.48	2.18	-	0.42	-	-	1.03	2.06	0.82	1.76	0.97	4.16	-	1.87	2.86	5.52	0.92	5.58
	Max.	-	-	51.6	53.4	46.4	44.5	44.6	43.8	44.2	43.9	39.7	-	43.3	-	-	43.0	45.6	43.0	41.9	41.6	50.6	-	45.6	45.3	49.2	41.0	51.3
	Min.	-	-	41.7	44.7	41.0	43.0	41.4	38.9	37.3	41.8	46.0	-	43.9	-	-	40.1	39.8	40.9	37.1	39.3	41.9	-	40.1	40.2	38.7	39.2	43.4
	N	1	1	5	2	5	4	5	5	7	2	9	-	2	-	-	5	7	5	8	4	4	-	7	3	3	3	2
tail fork-depth (mm)	males																											-
	mean	10.2	-	11.3	12.2	-	-	10.2	12.8	11.6	10.8	9.0	10.8	8.7	9.0	10.4	8.2	10.1	12.0	8.8	11.6	10.6	12.0	11.8	11.2	9.1		-
	±S.D.	1.48	-	2.06	3.15	-	-	-	1.76	1.76	2.14	1.26	1.70	2.68	1.06	3.6	2.72	2.64	1.20	2.80	1.48	1.75	0.07	1.55	1.13	2.29		-
	Max.	11.2	-	13.3	14.2	-	-	-	14.1	14.6	13.8	10.3	12.0	10.6	10.4	12.9	10.4	12.8	12.9	13.3	13.3	12.4	12.0	15.0	12.0	11.1		-
	Min.	9.1	-	9.2	8.6	-	-	-	11.6	9.5	7.5	7.3	9.6	6.8	7.5	6.3	4.4	5.2	10.6	1.5	10.4	8.9	11.9	10.0	10.4	6.6		-
	N	2	-	3	3	-	-	1	2	7	6	4	2	2	6	3	4	7	3	21	3	3	2	8	2	3		
	females																											
	mean	5.2	4.1	8.2	11.6	5.6	6.8	7.2	6.9	6.0	5.8	5.8	-	6.4	-	-	4.5	5.5	5.8	4.3	4.0	6.8	-	5.6	6.0	7.8	6.0	10.9
	±S.D.	-	-	2.87	5.30	1.80	0.95	1.52	1.07	2.84	2.26	2.72	-	1.20	-	-	0.36	2.94	1.32	1.44	0.57	2.72	-	2.96	2.38	5.54	0.46	4.24
	Max.	-	-	12.7	15.3	8.0	7.8	9.4	8.1	8.1	7.4	2.9	-	5.6	-	-	5.0	10.2	7.5	6.0	4.6	10.8	-	10.4	8.8	14.2	6.5	13.9
	Min.	-	-	4.8	7.8	3.5	5.9	5.8	5.5	0.4	4.2	9.8	-	7.3	-	-	4.2	0.7	4.3	2.0	3.3	4.6	-	2.1	4.4	4.1	5.6	7.9
	N	1	1	5	2	5	3	4	5	6	2	9	-	2	-	-	4	7	5	8	4	4	-	7	3	3	3	2



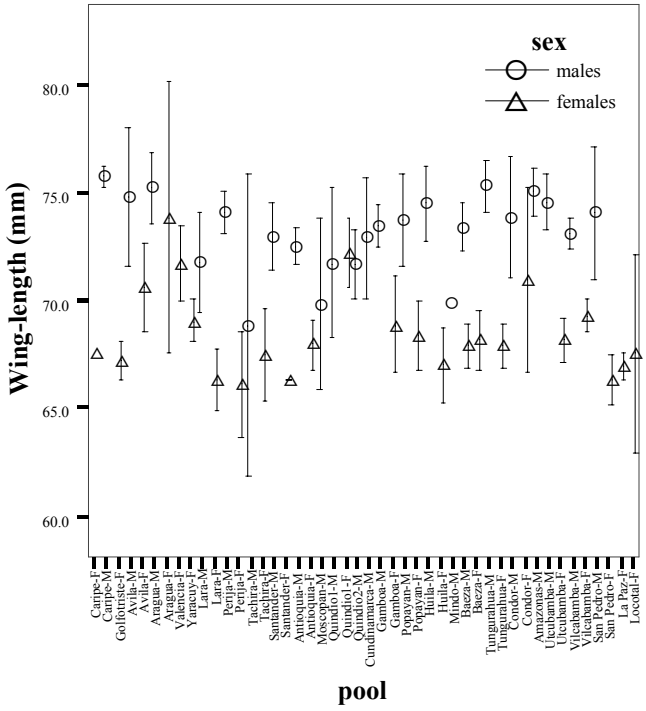


Figure 2.1.3. Geographic variation of the bill- and wing-lengths in *C. coeligena*. The circles represent and triangles represent the arithmetic mean in males and females, respectively, and the vertical lines the standard error of the mean. Pools are ordered geographically, from north to south.

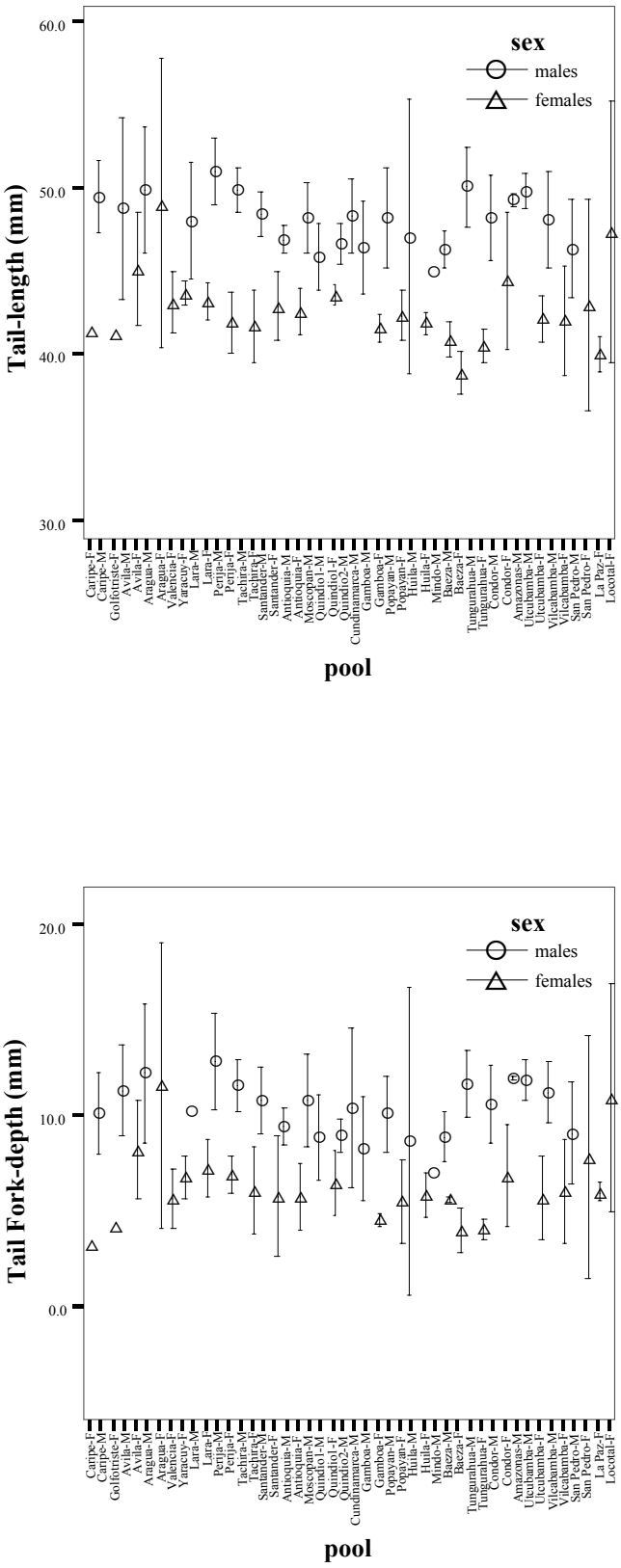


Figure 2.1.4. Geographic variation of the tail-length and the tail fork-depth in *C. coeligena*. The circles represent and triangles represent the arithmetic mean in males and females, respectively, and the vertical lines the standard error of the mean. Pools are ordered geographically, from north to south.

1.2 *Coeligena phalerata* (Bangs, 1898)

1.2.1 Geographic distribution and taxonomy

Coeligena phalerata is a monotypic species, exclusive to the Sierra de Santa Marta, in northern Colombia. The species was described as *Leucuria phalerata* by Bangs (1898), with one male specimen from Macotama, Colombia, collected in June 1898 by W. W. Brown, Jr. (erroneous type locality: actually San Miguel, Cerro Caracas. See Todd & Carriker 1922).

Hartert 1900 placed the species in the genus *Helianthea* Gould, 1848, this being the classification maintained by several authors (Berlioz 1936, Chapman 1917) excepting Simon (1921), who gave the name *Leucuria phalerata* Bangs, 1898 as the valid name.

Peters (1945) listed the species under the genus *Coeligena* Lesson, 1832, *Coeligena phalerata* (Bangs, 1898) being the current species name (Fjeldså & Krabbe 1990, Schuchmann 1999).

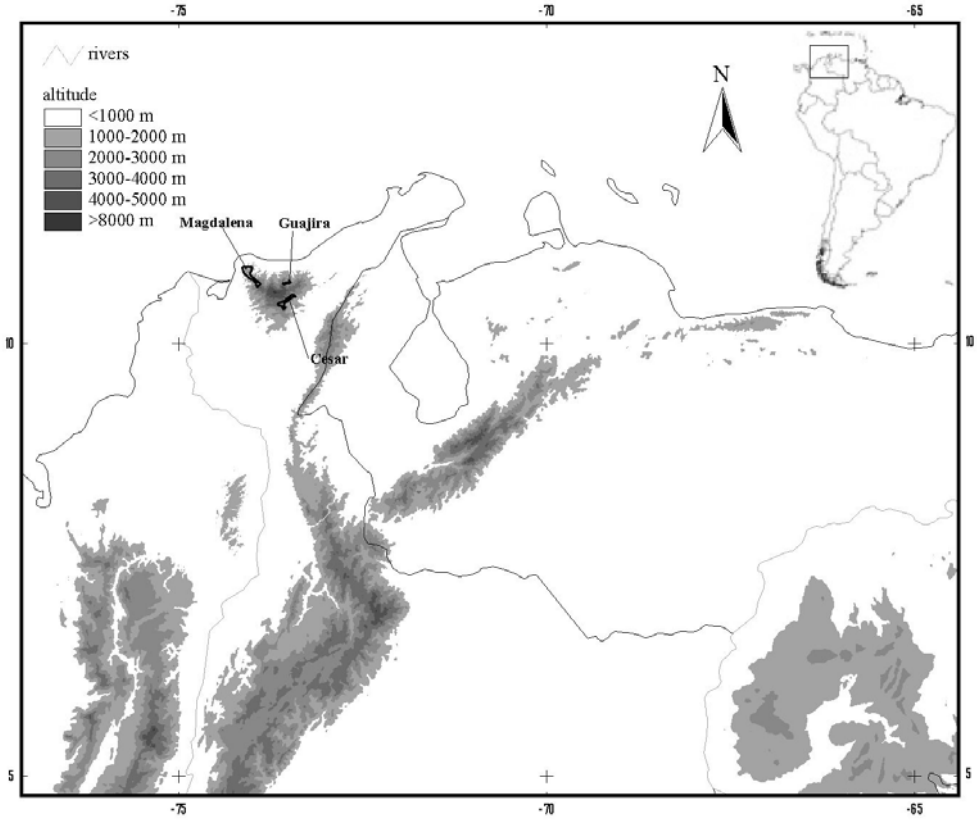


Figure 2.2.1 Geographic distribution of *Coeligena phalerata*. Polygons represent the geographic pools, dots the localities.

1.2.2 Diagnosis

Coeligena phalerata is a sexually dimorphic species, the males showing a metallic greenish turquoise Spectrum Green 62 crown; upperparts Dark Green 262 fringed golden; upper tail-coverts pure white. The chin is dark Parrot Green 260; throat metallic Spectrum Violet 72; underparts glittering Parrot Green 160; under tail-coverts pure white. The rectrices are white; wing-coverts like upperparts; remiges dark Raw Umber 223 without pale border on the outer primary feather. The females are similar to the males, with upperparts glittering golden Olive-Green 49; underparts pale Cinnamon 39; under tail-coverts Cinnamon 39; rectrices Olive-Green 49 tipped tawny white. Immature is similar to adult females.

1.2.3 Geographic variation analysis

A total of 25 males and 24 females of *Coeligena phalerata* was analysed and grouped into three geographical pools:

1. Magdalena: located on the north-western slope of the Sierra de Santa Marta, north of Colombia, between 1850 and 2500 m a.s.l.

2. Guajira: located on the north-eastern slope of the Sierra de Santa Marta, north Colombia, above 1700 m.

3. Cesar: located on the south-eastern slope of the Sierra de Santa Marta, north Colombia, between 1800 and 3300 m.

1.2.3.1 Morphometric variation

No significant variation was found in the specimens between pools (Tab. 2.2.1, Fig. 2.2.2-3). No differences were found between the specimens examined, the males having metallic Cobalt 68-Smalt Blue 70 with frontal spot metallic Spectrum Green 62; nape very blackish Dark Green 262; upperparts Dark Green 262; upper tail-coverts white. The chin is very Dark Green 262; throat with metallic True Violet 172 gular spot, with sides like chin; underparts bluish-yellowish Spectrum Green 62; belly more greenish with lower belly white; under tail-coverts white. The rectrices are white; wing-coverts like upperparts; remiges dark Fuscous 21 without pale borders.

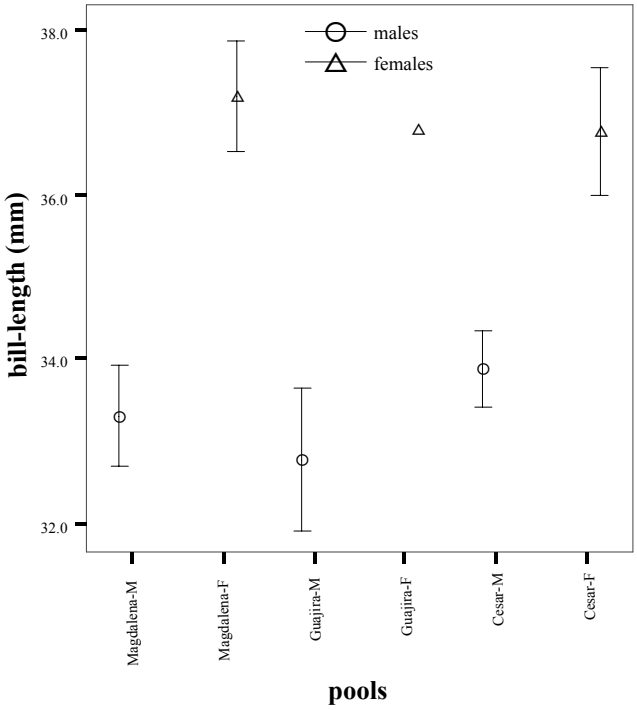
Table 2.2.1. Descriptive statistics of the morphometric parameters of *C. phalerata*. The pools are ordered geographically from north to south.

Morphometric parameter		Magdalena	Guajira	Cesar
bill-length (mm)	males			
	mean	33.3	32.8	33.8
	±S.D.	0.88	0.75	0.76
	Max.	34.4	33.5	35.2
	Min.	32.1	32.0	32.6
	N	8	3	11
	females			
	mean	37.2	36.8	36.8
	±S.D.	1.16	-	1.09
	Max.	39.9	-	38.4
	Min.	35.9	-	35.3
	N	12	1	8
wing-length (mm)	males			
	mean	72.6	73.0	74.9
	±S.D.	2.52	1.31	1.62
	Max.	76.5	75.1	77.3
	Min.	69.5	71.5	72.4
	N	7	5	11
	females			
	mean	68.2	70.0	68.4
	±S.D.	1.16	-	1.52
	Max.	70.1	-	70.4
	Min.	66.2	-	65.8
	N	13	1	10
tail-length (mm)	males			
	mean	48.2	47.0	48.2
	±S.D.	2.74	1.10	1.09
	Max.	52.3	48.0	49.7
	Min.	44.2	46.0	46.3
	N	6	4	9
	females			
	mean	41.5	42.0	41.9
	±S.D.	1.46	-	0.71
	Max.	44.5	-	42.8
	Min.	39.0	-	40.6
	N	12	1	10
tail fork-depth (mm)	males			
	mean	10.1	11.2	11.1
	±S.D.	3.34	1.04	0.81
	Max.	14.4	12.6	12.5
	Min.	6.4	10.2	9.6
	N	5	4	9
	females			
	mean	5.42	7.0	5.3
	±S.D.	1.44	-	0.66
	Max.	8.1	-	6.4
	Min.	2.6	-	4.3
	N	10	1	10

1.2.3.2 Plumage variation

The females are similar to the males, with the head Parrot Green 160, although some specimens of the same series exhibited a metallic Spectrum Green 62 front spot on the head on a greyish background; upperparts yellowish-reddish Parrot Green 160; upper tail-coverts yellowish Olive-Green 47. The chin, throat and chest are reddish Cinnamon 39; lower breast and belly like chest mottled black and green; under tail-coverts Cinnamon 39, with centre Olive-Green 47. The outer primary has pale Cinnamon 39 border.

The three pools represent the taxon *C. phalerata* (Fig. 2.2.1), whose phylogenetic relationships with other members of the genus *Coeligena* will be treated later in the chapter 'Phylogenetic Relationships, Biogeography and Taxomomic Conclusions'.



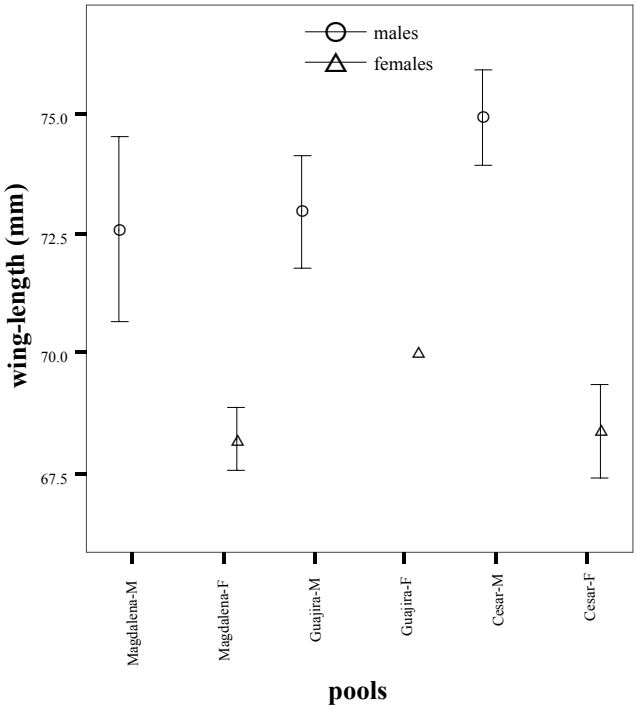
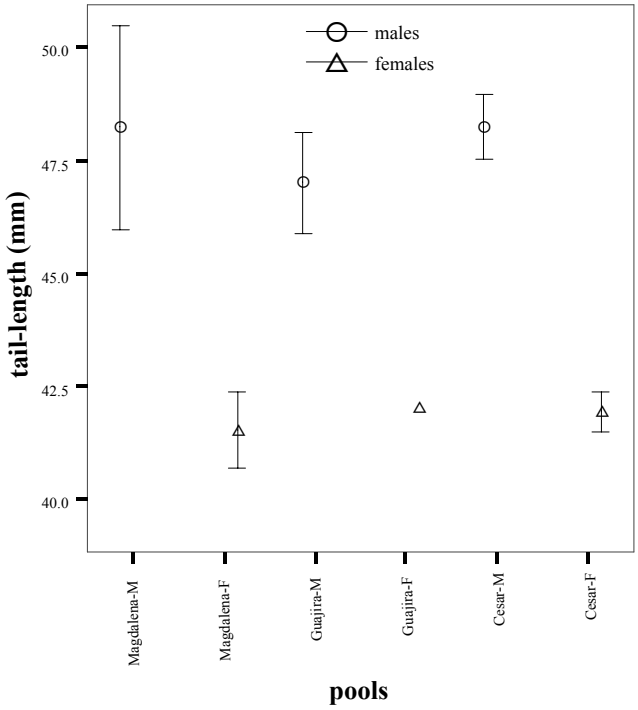


Figure 2.2.2. Geographic variation of the bill and the wing-length in *C. phalerata*. The circles represent and triangles represent the arithmetic mean in males and females, respectively, and the vertical lines the standard error of the mean. Pools are ordered geographically, from north to south.



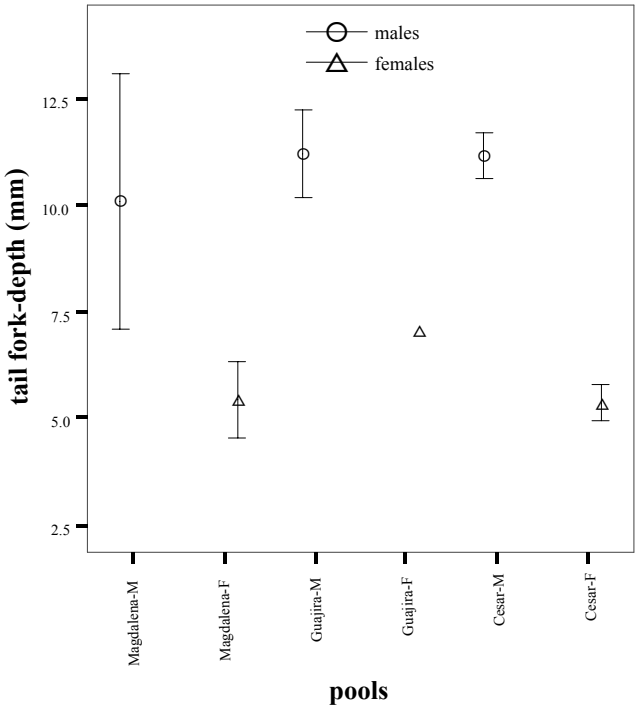


Figure 2.2.2. Geographic variation of the tail-length and the tail fork-depth in *C. phalerata*. The circles represent and triangles represent the arithmetic mean in males and females, respectively, and the vertical lines the standard error of the mean. Pools are ordered geographically, from north to south.

1.3 *Coeligena torquata* (Boissonneau, 1840)

1.3.1 Geographic distribution and taxonomy

Coeligena torquata range extends from western Venezuela southwards to southern Peru, over the Central, East and West Andes. Currently, eight subspecies are recognised, *C. t. conradii*, *C. t. torquata*, *C. t. fulgidigula*, *C. t. margarethae*, *C. t. insectivora*, and *C. t. einsenmanni. C. t. conradii* is apparently confined to the Merida region, in western Venezuela, although some authors extend its ranges to Norte de Santander in the East Andes of Colombia (Peters 1945, Hilty & Brown 1986, Fjeldså & Krabbe 1990, Schuchmann 1999).

The nominate subspecies shows a continuous distribution throughout the Central and East Andes of Colombia and Venezuela (Tachira), extending southward to the Andes of northern Peru. By contrast, *C. t. fulgidigula* is confined to the West Andes of Ecuador, and *C. t. margarethae* occurs in the Chachapoyas area in the Andes of northern Peru, directly south of the nominate subspecies. *C. t. insectivora* inhabits the Central Peruvian Andes. The sixth subspecies, *C. t. einsenmanni*, is restricted to the Cordillera de Vilcabamba, in southern Peru.

The taxonomy of this species has been stable over the time, presenting the usual changes from one genus to another. The nominate subspecies was described by Boissoneau (1840) as *Ornismia torquata*, based upon an apparently immature unsexed skin. The holotype is deposited in the Natural History Museum in Tring as part of the Loddiges Collection. No data on the collecting site are given (Warren 1966). The description of *C. t. insectivora* was made by Tschudi (1844) from a bird from "Peru", with no more details, and named *Trochilus insectivorus*. There is not much information about the holotype, but there is one syntype (female) deposited in the Tring museum. In the same decade, *C. t. conradii* was described by Bourcier (1847) as *Trochilus Conradi* from an adult male from the "vicinity of Caracas" (holotype deposited in Tring), which was obviously an error because this taxon is restricted to the Venezuelan Andes range. Bourcier (*op. cit.*) remarked the plumage resemblance of this new taxon to '*Trochilus torquatus* Boiss.'.

Gould (1854) described *Bourcieria fulgidigula* from skins collected in Peru and Ecuador (the syntype in Tring is labelled with 'Ecuador' as type locality). He stated the distinctness of this taxon from *Trochilus insectivorus* Tschudi, 1844, but only compared its crown and throat coloration with the more similar *Bourcieria torquata* (Boissonneau, 1840), notwithstanding that by the time of this race description, Bonaparte (1850) had already merged *Trochilus insectivorus* Tschudi, 1844 into *Trochilus torquata* (Boissonneau, 1840) and lumped them

into the genus *Bourcieria* Bonaparte, 1850, together with *Trochilus conradi* Bourcier, 1847. Later, Gould (1861) adopted the Bonaparte classification, and separated *B. insectivora* (Tschudi, 1844) from *B. torquata* (Boissonneau, 1840).

Mulsant & Verreaux in 1866 described the taxon *Diphlogæna (Helianthea) traviesi*, known only from skins found in Bogota trade lots (Peters 1945). This taxon was considered a valid species until Simon (1921) considered it to be a hybrid of *C. torquata* with another *Coeligena* species. Hartert (1900) included all the above mentioned taxa in the genus *Helianthea* Gould, 1848 and commented on the probable hybrid origin of *H. traviesi* (suggested by Simon in a personal communication). Simon (1921) rearranged the taxonomy of this species group, re-adopting the taxonomy of Gould (1861) and Elliot (1878).

Peters' (1945) check-list included as subspecies of *Coeligena torquata* (Boissonneau, 1840) all those taxa formerly included in *Bourcieria* Bonaparte, 1850 and *Helianthea* Gould, 1848. Zimmer (1948) described *C. t. margarethae* from an adult male with type locality 'La Lejía, N of Chachapoyas, Peru. 9000 feet [*c*. 3000 m]' which is distinguishable from other subspecies by two separated spots on the crown and other minor characters concerning throat and mantle (upper and lower back) colour. The sixth subspecies, *C. t. eisenmanni*, was relative recently described by Weske (1985) from an adult male from 'Cordillera Vilcabamba, Departamento de Cuzco, Peru. 2170 m' and is distinguished by the shining bronze upper tail-coverts.

There is enough evidence from *C. t. conradii* and the unit '*C. t. insectivora*-*C. t. margarethae*-*C. t. eisenmanni*' the morphology and biogeography that suggest that these taxa are good species (this will be discussed later on). The isolated range and morphological character differentiation indicate the presence of three allospecies, members of the superspecies *Coeligena torquata* (see below).

1.3.2 Diagnosis

Coeligena torquata is a relatively large.sized, markedly dimorphic species that presents a plumage pattern that is retained between subspecies. Males have a long straight, black bill. The head is black with a glittering dark purple crown spot (True Violet 172). The upperparts (nape and upper back) are blackish Hooker's Green 162, becoming Dark Green 162A on the lower back (and upper tail-coverts); chin and throat are black with Hooker's Green 162 discs, broad white pectoral collar extends on throat and breast. The underparts are blackish Hooker's Green 162 with the under tail-coverts Peacock Green 162C. The tail is forked with inner

rectrices dark golden Greenish Olive 49 and the others white with contrasting dark golden green tips varying in size. Females have longer bills than males; head Peacock Green 162C lacking purple crown spot with upperparts shining golden Emerald Green 163; chin grey with some green discs (like upperparts); large white collar; belly dark grey with some golden green discs; under tail-coverts grey-green, fringed white and tail less forked. Immature is similar to adult females with head feathers fringed Buff 124.

1.3.3 Geographic variation analysis

A total of 338 skins of *Coeligena torquata* (200 males, 111 females and 27 immatures) were examined. The localities were grouped in 22 geographic pools (Fig. 2.3.1). Below is a list of these pools and the descriptions of the corresponding areas, ordered from north to south.

1. Merida: located in the Merida Valley, western Venezuelan Andes, between 1500 and 4000 m.

2. Tama: located on the paramo Tama, on the border of Venezuela and Colombia, in the East Andes, between 1800 and 2800 m a.s.l.

3. Las Vegas: located west of Tama on the Colombian East Andean branch that leads to the Serrania de Perija, at 1940 m.

4. Bucaramanga: located in the surroundings of Bucaramanga, on the western slope of the Colombian West Andes, at 1000 m.

5. Cundinamarca: located near Bogota, on the western slope of the Colombian West Andes, between 1750 and 3150 m.

6. Antioquia: located the west bank of the River Magdalena, on the western slope of the Colombian Central Andes, between 1500 and 3600 m.

7. Tolima: located near Nevado El Tolima, south of Antioquia, on the western Andes slope, between 2200 and 3300 m.

8. Monchique: located near the National Park Monchique in southern Colombia, near the border with Ecuador, in the West Andes, between 1600 and 3400 m.

9. Moscopan: located near the headwaters of the River Magdalena and Nevado del Huila, between 2300 and 2750 m.

10. Llorente: located on the border of Colombia and Ecuador, on the eastern slope of the Andes, at 1700 m.

11. East Pichincha: Located on the eastern slope of the Pichincha Volcano, near Quito, in northern Ecuador, between 1375 and 3750 m.

12. Tungurahua: located near Tungurahua on the eastern slope of the central Ecuadorian Andes, between 1140 and 2600 m.

13. Morona: located near Gualacea, Morana-Santiago, on the western slope of the Andes of central Ecuador, between 2300 and 2700 m.

14. Zamora: located south of the River Marañon; between southern Ecuador and northern Peru, on the eastern slope of the Andes, between 1950 and 2800 m.

15. Pichincha: located near Pichincha, on the western slope of the northern Ecuadorian Andes, between 1500 and 4800 m a.s.l

16. Chimborazo: located near the Chimborazo Volcano, on the western slope of the central Ecuadorian Andes, between 1500 and 2750 m.

17. Amazonas: located on the eastern bank of the River Marañon, near Chachapoyas, in northern Peru, at 2950 m.

18. San Martin: located on the eastern bank of the River Marañon in central Peru, between 2200 and 2950 m.

19. Utcubamba: located directly south of San Martin, on the eastern bank of the River Marañon, central Peru, at 2630 m.

20. Carpish: located south of the headwaters of the River Marañon, on the Carpish mountain range, on the eastern slope of the central Peruvian Andes, between 2100 and 2600 m.

21. Chilpes: located near the Apurimac Reserve Zone, south of the Carpish pool, southern Peru, between 2200 and 3000 m.

22. Ayacucho: located near Ayacucho, on the western bank of the River Apurimac, southern Peru, between 1900 and 2600 m.

23. Vilcabamba: located on the eastern bank of the River Apurimac, in the Vilcabamba mountain range, southern Peru, between 2150 and 2650 m.

1.3.3.1 Morphometric variation

Coeligena torquata shows a marked morphometric dimorphism; males have shorter bills and longer wings and tails than females. The morphometric significant differences were found mainly in male bill-lengths (Fig. 2.3.3, Tab. 2.3.1). Specimens from Merida (pool 1) have shorter bills (males: 37.4±1.14 mm; females: 39.0±1.13 mm) than its neighbouring pools Tama (pool 2, males: 40.2±1.58 mm; females: 41.7±0.72 mm), Las Vegas (pool 3, males: 40.9±0.63 mm; females: 42.1 mm) and Bucaramanga (pool 4, males: 39.8±0.35 mm; females: 40.7 mm, $p<0.05$). Following the eastern slope of the Andes, it was found that from Cundinamarca (pool 5, with shorter bill, $p<0.05$, males: 37.0±1.10 mm; females: 39.6±1.27 mm) southwards, there is a clinal increase in bill-length, reaching a maximum in Zamora (pool 14, males: 40.2±1.21 mm; females: 41.1±1.56 mm). The values of bill-length are approximately constant between Amazonas and Utcubamba (pools 17-19). From Carpish (pool 20, males: 37.6±2.40 mm; females: 40.0±2.58 mm), bill-length declines, reaching its lowest value in Ayacucho (pool 22, males: 36.3 mm; females: 40.4±1.99 mm). Specimens from Vilcabamba (pool 23) have bills of moderate length (males: 38.2±1.04 mm; females: 39.5±2.04 mm). An evident clinal increase was found in male bill-lengths with very significant differences between pools of equivalent latitude on the Central, East and West Andes ($p<0.01$). Specimens from Antioquia (pool 6, males: 36.8±1.69 mm; females: 38.0±1.30 mm) and Tolima (pool 7, males: 36.2±1.13 mm; females: 37.7±1.46 mm) have significantly shorter bills. Bill-length increases southwards, with Moscopan specimens (pool 9) having intermediate bill-lengths (males: 37.2±1.21 mm; females: 41.1±1.56 mm). Specimens from Pichincha (pool 15, males: 38.8±1.50 mm; females: 40.8±1.31 mm) and Chimborazo (pool 16, males: 40.6.9±1.24 mm; females: 41.3±0.28 mm) present the longest bill-length on this Andes branch and with values similar to those found in specimens from Zamora (pool 14).

Morphometric variation was also found in male tail-length and tail fork-depth (Fig. 2.3.4). Males from Merida (pool 1) have significantly shorter tails ($p<0.05$, males: 44.4±1.05 mm; females: 40.0±1.48 mm) than those from Tama (pool 2, males: 46.5±1.22 mm; females: 40.1±2.02 mm) and Las Vegas (pool 3, males: 48.0±0.64 mm).

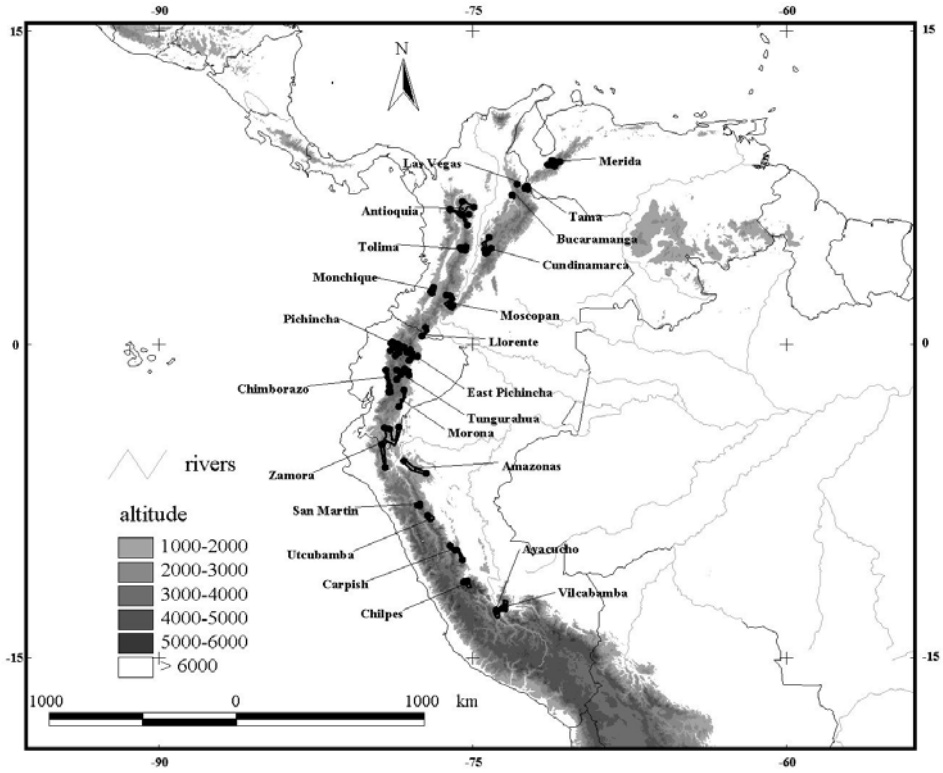


Figure 2.3.1. Geographic distribution of *Coeligena torquata.* The dots represent the localities, polygons the geographic pools. The names of the pools correspond with the description on the text.

The shortest tails were found in Chilpes (pool 21, males: 43.9±7.50 mm) and Ayacucho (pool 22, males: 42.9 mm; females: 41.4±0.77 mm) specimens. Merida specimens (pool 1) have the most deeply forked tail (males: 7.2±1.37 mm; females: 3.6±1.28 mm) and Tungurahua's (pool 12) the least deeply forked tail (males: 2.8±2.04 mm; females: 1.2±1.48 mm). Specimens from Vilcabamba (pool 23) have intermediate tail-lengths and tail fork-depths. No significant variation was found in the wing-length. Tungurahua individuals (pool 12) tend to have relatively short wings (males: 74.1±2.80 mm; females: 72.6±1.20 mm) and those from Morona and Zamora (pools 13 and 14) the longest wings (males: 79.6-79.4 mm).

Summarising, mean bill length of the population from the northern East Andes is *c.* 1.3 mm longer than that of the population in the south Peruvian Andes. The mean bill-length of the populations from the East Andes is *c.* 4.7 mm longer than that of the populations on the Central Andes, which on its part is *c.* 2.7 mm shorter than the mean length of the population on the western slope of the Ecuadorian Andes. The Merida population is distinguishable by its longer tail and deeper tail fork.

1.3.3.2 Plumage coloration

Coeligena torquata presents a relatively homogeneous coloration pattern throughout its range, with the white pectoral collar being constant (see description in 'Diagnosis'). Nevertheless, differences were found between pools. For this reason, the pools were sorted into five groups, according to the degree of similarity in plumage coloration. The first group is the Merida pool (pool 1), which constitutes a separate unit that strikingly differs from the general pattern. The males are immediately recognisable by the total absence of the violet crown and of black on the head, nape and upper back. The whole body is mainly yellowish-bluish Spectrum Green 62 with more yellow-golden fringes on the head and more bluish Parrot Green 160 on the upperparts. The chin and underparts (excluding the white pectoral collar), and the under tail-coverts have the same colour as the upperparts. The upper tail-coverts and innermost rectrix are Yellowish Olive-Green 50. The second and third inner rectrices are symmetrically white on the basal two thirds and yellowish olive on the terminal third; the two outer rectrices have an asymmetric white base, more reduced laterally. The complete tail shows a two-lobed symmetrical white pattern bordered olive. The wing-coverts have the same colour as the upperparts. The female upperparts, upper tail-coverts and rectrices are similar to those of males. The chin has the same colour as in males, presenting a much reduced scaly pattern mixed with white, on pale buff background (Pale Horn Colour 92). The white pectoral collar covers the throat and part of the chest. The remaining underparts are Parrot Green 160 mottled white.

The second group is formed by the pools in the Central and East Andes and on the western slope of the Ecuadorian and north Peruvian Andes. They did not show striking deviations from the common pattern of the species (see section 'Diagnosis' for an overview of the species aspect). Variation in both sexes was mostly detected in specific structures, like crown spots (form and colour), chin and tail-coverts colour. Males from the pools Tama and Antioquia (pools 2 and 6), southwards to Llorente (pool 10, on the Ecuadorian border) and through Ecuador, on the eastern slope of the Ecuadorian Andes to Zamora (pool 14, on the Peruvian border), have a very blackish green head with one central bluish-greenish metallic Spectrum Violet 72 spot. The upperparts and underparts are very dark blackish Leaf Green 146 and the upper tail-coverts dark Greenish Olive 49. The chin near the bill has glittering bluish Parrot Green 160 scales with blackish sides. The under tail-coverts are dark Greenish Olive 49. In females the head is bluish dark green, with no crown spot; upperparts and upper tail-coverts yellowish-bluish Spectrum Green 62; chin with scaly yellowish Parrot Green 160

in small discs on white background. The underparts are yellowish dark green mottled with black and greyish white, under tail-coverts yellowish Parrot Green 160 bordered white.

Males from the third group, formed by the Pichincha and Chimborazo pools (15 and 16), have heads, crowns, upperparts and under tail-coverts similar to the pools described above. The chins are very glittering greenish Cobalt 68 with no black on sides. The upperparts in females are slightly more reddish than in males. The chin shows a scaly green pattern, with some more bluish. The underparts, below the white collar, are greyish Parrot Green 160 mottled with brownish white and black. The other bodyparts showed no variation from the general pattern described in the 'Diagnosis' section.

Males from the fourth group (Amazonas, San Martin and Utcubamba pools: 17-19) have a strikingly different crown pattern, with two glittering crown spots: one frontally Cobalt Blue 168, at the bill base, and the other bluish Spectrum Green 62, on the centre of the very dark blackish green head; upperparts less blackish. The underparts are not different from the overall pattern. In females, the upperparts are bronzy Parrot Green 160 with bronzy fringes and the upper tail-coverts greenish olive. The chin is Parrot Green 160, mixed with Tawny Olive 223D. The underparts, below the white collar, are yellowish green.

The males from the fifth group formed by the Carpish, Chilpes, and Ayacucho pools (20-22), have one central metallic golden Spectrum Green 62 spot; nape blackish and upperparts bluish Dark Green 262 with no bronzy fringes. There is no significant variation in the underparts. The tail feathers are Grayish Olive 43. The females lack the bluish tonality of the upperparts. The chin is distinct due to the reduced green scaly pattern and the rather brownish white background. The underparts and under tail-coverts are bluish Spectrum Green 62, mottled white and black; rectrices strikingly turquoise-olive with white in the pattern described above.

The sixth group is constituted by the pool Vilcabamba (23). Males from this pool have one central golden Spectrum Green 62 crown spot on the very blackish green head; nape like head. The upperparts are yellowish Parrot Green 160. Males in this pool can be distinguished by the bright golden bronze on the upper tail-coverts and inner rectrices, and the narrower white pectoral collar. The chin is very dark blackish green (almost black) and the throat bright bluish yellowish Parrot Green 160, similar to that observed in males from The Merida pool; the rest of the underparts and the under tail-coverts are like the throat. The females share the golden bronze coloration of the upper tail-coverts and inner rectrices with the males, being very similar to the females from Merida pool in sharing the reduction of the green scaly

pattern on the pale buff background (Pale Horn Colour 92). The underparts are emerald green mottled white and the under tail-coverts olive.

1.3.4 Discussion

In the current taxonomy, the Merida pool (Fig. 2.3.2) corresponds with the name *Coeligena torquata conradii* (Bourcier, 1847). This taxon shows great differences from the general pattern not seen in the other pool groups, being recognisable and very distinguishable by its coloration particularities and its significant morphometric differences in bill and tail-lengths, together with the fact that no evidence for intergradation with neighbouring races was found. On this basis I have no hesitation in promoting it to species level: *Coeligena conradii* (Bourcier,1847).

The second pools group corresponds with the nominate form of *Coeligena torquata*, *C. t. torquata* (Boissonneau, 1840), with a wide extention. Nonetheless, the pools that form it are distinguishable from the other groups in coloration, and do not show significant differences within themselves, whereas morphometrically there are several very marked clinal changes in male bill-lengths in both north-south and east-west directions (Fig. 2.3.2).

The third pools group corresponds with the taxonomic name *C. t. fulgidigula* (Gould, 1854). This group is morphometrically distinguishable from the others by the relatively long bills but still within the value range of the *C. torquata* subspecies (Fig. 2.3.2-3). Nevertheless, the group is distinguishable mainly by the blue coloration on the throat.

Change in the presence and state of one character, such as the crown, represents an important step toward a higher differentiation between groups, having been used for the definition of specific groups in other trochilids (e.g., *Thalurania* spp, Valdés-Velásquez, pers. comm.), and is usually the product of an effective isolation due to geographic barriers. The new state may represent a character displacement that would ensure an effective impediment to hybridising between the populations in occasional contact zones.

The change from violet to green in the crown spot coloration in the fourth, fifth and sixth pool groups, illustrates this case. The barrier is clearly defined by the River Marañon, which interrupts the Andes range continuity by a huge low-altitude arid region, so that the group of pools on the west bank of the River Marañon (from Amazonas southwards to Vilcabamba) form a distinguishable unit differentiated at the species level. Since the name described by

Tschudi (1844) has priority as being the older name assigned to the taxa present in those pool groups, the specific name might be *Coeligena insectivora* (Tschudi, 1844).

The type locality of the taxon *C. t. margarethae* Zimmer, 1948 corresponds with the fourth pool group. Morphologically, the pools forming the group are not distinct from the other pools of *C. torquata*, showing a rather intermediate size (Fig. 2.3.3-4), but they show impressive changes in crown form and colour. The group is characterised by the substitution of violet by green-blue on the crown (diagnostic character of *C. insectivora*) and the presence of two separate spots. According to this study, the taxon's name might be *Coeligena insectivora margarethae* (Zimmer, 1948) (Fig. 2.3.2).

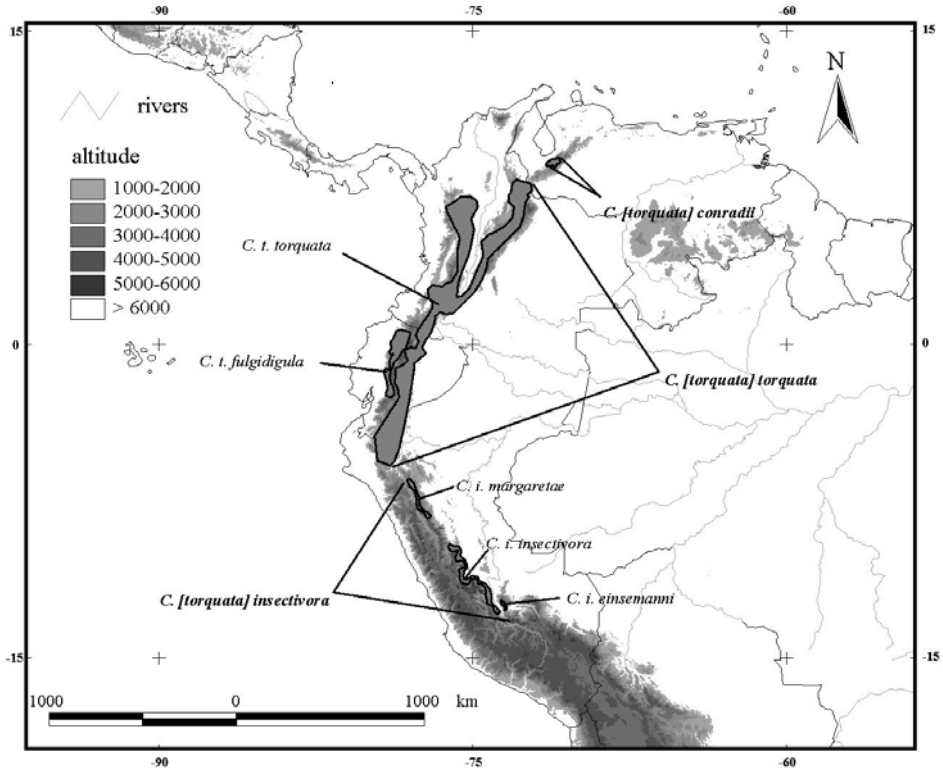


Figure 2.3.2. Map with the distribution ranges of the allospecies of the superspecies complex *Coeligena torquata*. Bold fonts are used to refer to the allospecies, plain fonts for the subspecies of each allospecies.

The fifth group corresponds taxomically with the name *C. t. insectivora* (Tschudi, 1844). The males of this group have the shortest bills of the species (Fig. 2.3.3). The plumage coloration does not differ significantly from the other pools. The most important change observed is the substitution of violet by green-blue and the disappearance of the frontal spot. The central green spot observed in the group *C. t. margarethae* is maintained. According to this study, the taxon represents the nominate subspecies of *C. insectivora* (Fig. 2.3.2).

The sixth and last group is formed solely by the pool Vilcabamba. The type locality given by Weske (1985) for *C. t. eisenmanni* Weske, 1985 corresponds with this pool. This population has unique characters that suggest some intermediate status between *C. torquata* and *C. inca*. No morphometrically significant differences were found between this pool and the other neighbouring pools (*contra* Weske 1985). The most striking distinction of this group is the bronzy coloration of the upper tail-coverts and inner rectrices. Also the crown shows one green central spot and the pectoral white collar is relatively narrower. Females resemble those from the Merida pool. No other deviation from the general pattern of the species was found. According to this study, the taxon's name might be *Coeligena insectivora eisenmanni* (Weske, 1985), due to the presence of the diagnostic green coloration of the crown spot (Fig. 2.3.2).

The species of the *C. torquata* group, together with their neighbouring species *C. inca* form a superspecies complex, consisting of allopatric species with a high degree of similarity. The systematic and biogeographic relationships of these taxa will be treated in the next chapter.

Table 2.3.1. Descriptive statistics of the morphometric parameters of *C. torquata* (*C. conradii* and *C. insectivora* are included. See text for details). The pools are ordered geographically from north to south.

Morphometric parameters	**Pools**	Merida	Tama	Las Vegas	Bucaramanga	Cundinamaca	Moscopan	Llorente	East Pichincha	Tungurahua	Morona	Zamora	Amazonas	San Martin	Utcubamba	Carpish	Chilpes	Ayacucho	Vilcabamba	Antioquia	Tolima	Monchique	Pichincha	Chimborazo
bill-length (mm)	males																							
	mean	37.4	40.2	40.9	39.8	37.0	37.9	39.6	38.9	38.0	40.2	38.8	39.1	40.0	39.2	37.6	37.8	36.3	38.2	36.8	36.2	38.9	38.8	40.6
	±S.D.	1.14	1.58	0.63	0.35	1.10	0.82	1.10	1.,04	1.22	3.32	1.21	2.40	1.36	0.38	2.40	3.46	-	1.04	1.69	1.13	1.08	1.50	1.24
	Max.	40.4	42.2	41.4	40.1	39.0	38.7	41.8	41.0	40.0	42.5	40.7	42.1	41.0	39.7	41.9	40.3	-	39.4	40.8	38.7	40.9	42.7	42.1
	Min.	38.4	38.6	40.5	39.6	35.2	36.7	37.6	36.9	36.8	37.8	37.7	36.1	38.5	38.8	35.8	35.4	-	37.4	35.2	34.7	37.5	34.9	38.7
	N	49	4	2	2	12	7	9	27	10	2	5	5	3	4	6	2	1	3	10	16	13	29	6
	females																							
	mean	39.0	41.7	42.1	40.7	39.6	39.0	41.1	41.2	38.2	42.4	41.1	44.2	42.0	43.0	40.0	-	40.4	39.5	38.0	37.7	40.5	40.8	41.3
	±S.D.	1.13	0.72	-	-	1.27	0.56	1.23	2.76	1.70	-	1.56	-	1.56	0.92	2.58	-	1.99	2.04	1.30	1.46	1.39	1.31	0.28
	Max.	41.4	42.7	-	-	40.5	39.5	43.1	49.9	39.4	-	42.2	-	43.1	45.0	42.1	-	42.1	41.8	40.4	38.9	42.3	43.9	41.5
	Min.	37.1	40.9	-	-	38.7	38.3	39.9	38.1	37.0	-	40.0	-	40.9	41.5	36.2	-	37.6	37.9	36.5	35.6	38.1	38.0	41.1
	N	25	7	1	1	2	4	8	13	2	1	2	1	2	12	4	-	4	3	9	4	7	20	2
wing-length (mm)	males																							
	mean	76.4	76.2	76.0	79.2	75.0	77.2	78.6	78.2	74.1	79.6	79.4	78.2	78.4	79.3	74.9	72.0	76.3	75.4	77.0	78.0	78.2	77.4	75.2
	±S.D.	2.26	0.85	2.05	1.70	3.94	2.60	2.13	2.34	2.80	0.49	1.72	1.94	0.80	1.49	2.96	8.48	-	2.20	1.54	2.92	3.06	1.70	3.84
	Max.	79.5	76.9	77.5	80.4	79.9	81.0	81.6	83.9	76.9	79.9	81.8	80.2	79.3	81.0	77.6	78.0	-	77.6	80.2	84.4	84.2	80.7	78.6
	Min.	69.1	75.0	74.6	78.0	65.1	74.3	74.3	73.2	68.9	79.2	77.0	75.0	77.7	77.4	69.6	66.0	-	73.2	74.8	73.2	71.2	73.4	68.5
	N	49	4	2	2	12	9	9	27	10	2	6	5	3	4	6	2	1	3	12	15	14	27	6
	females																							
	mean	70.2	69.8	72.8	69.2	70.5	70.6	72.1	71.1	72.6	66.6	70.0	75.3	72.2	72.0	71.8	-	72.0	71.7	71.2	71.2	72.6	72.1	68.9
	±S.D.	2.02	3.02	-	-	0.46	1.74	1.70	2.10	1.20	-	0.64	-	3.04	1.14	2.21	-	1.96	2.25	2.43	2.86	1.44	2.01	0.84
	Max.	76.8	73.0	-	-	70.9	72.7	74.0	75.3	73.5	-	70.5	-	74.3	73.6	74.7	-	74.1	73.1	75.8	74.8	74.8	76.4	69.5
	Min.	67.7	65.2	-	-	70.0	69.0	69.7	67.7	71.8	-	69.6	-	70.0	69.9	71.0	-	70.3	69.1	67.2	68.2	70.7	69.2	68.3
	N	24	5	1	1	3	4	8	13	2	1	2	1	2	12	4	-	4	3	9	5	9	19	2

Table 2.3.1.(Continued) Descriptive statistics of the morphometric parameters of *C. torquata* (*C. conradii* and *C. insectivora* are included. See text for details). The pools are ordered geographically from north to south.

Morphometric parameters	**Pools**	Merida	Tama	Las Vegas	Bucaramanga	Cundinamaca	Moscopan	Llorente	East Pichincha	Tungurahua	Morona	Zamora	Amazonas	San Martin	Utcubamba	Carpish	Chilpes	Ayacucho	Vilcabamba	Antioquia	Tolima	Monchique	Pichincha	Chimborazo
tail-length (mm)	males																							
	mean	44.4	46.5	48.0	45.3	44.6	47.8	46.6	47.1	44.4	47.2	48.8	48.4	49.2	47.9	46.0	43.9	42.9	47.9	48.0	46.9	47.9	45.8	46.2
	±S.D.	1.05	1.22	0.64	0.70	2.56	1.63	0.96	1.74	1.68	0.14	2.62	2.04	0.28	0.86	3.16	7.50	-	1.36	1.93	2.1	1.56	1.17	1.46
	Max.	47.1	47.9	48.4	45.8	47.1	50.5	48.2	49.7	46.6	47.3	52.2	50.9	49.4	48.4	49.2	49.2	-	49.4	50.6	51.2	51.1	48.0	48.4
	Min.	41.8	45.6	47.5	44.8	39.4	46.1	45.2	43.3	40.4	47.1	44.5	45.8	48.9	46.9	42.1	38.6	-	46.7	44.9	42.9	45.4	43.7	44.5
	N	50	3	2	2	11	5	9	27	10	2	6	5	.3	3	6	2	1	3	12	13	15	26	6
	females																							
	mean	40.0	40.1	-	42.4	41.4	41.2	41.4	41.0	41.2	41.3	42.8	43.9	43.5	42.6	42.2	-	41.4	42.6	42.8	41.6	41.6	40.6	43.1
	±S.D.	1.48	2.02	-	-	1.53	0.72	0.64	1.10	0.21	-	0.07	-	0.28	1.32	1.67	-	0.77	2.43	2.27	1.16	1.22	1.46	2.12
	Max.	43.7	42.0	-	-	43.2	42.1	41.9	42.1	41.4	-	42.9	-	43.7	44.4	44.7	-	41.8	45.3	48.4	43.2	44.0	44.2	44.6
	Min.	38.1	37.1	-	-	40.5	40.4	40.4	38.3	41.1	-	42.8	-	43.3	40.1	41.2	-	40.2	40.5	41.0	40.6	39.7	37.4	41.6
	N	25	6	-	1	3	4	8	13	2	1	2	1	2	9	4	-	4	3	9	4	10	20	2
tail fork-depth (mm)	males																							
	mean	7.2	4.9	5.8	3.7	4.6	6.2	4.4	5.0	2.8	3.4	5.0	5.4	6.2	6.4	4.9	7.8	2.4	5.5	6.0	5.4	5.3	4.8	4.9
	±S.D.	1.37	1.56	0.92	2.12	2.06	1.28	1.28	1.40	2.04	0.49	1.28	2.25	0.38	0.52	3.45	-	-	0.98	2.12	1.46	1.74	1.43	1.24
	Max.	10.7	6.0	6.5	5.2	8.6	7.2	6.6	8.1	5.7	79.9	6.4	7.9	6.7	7.0	8.5	-	-	6.1	9.0	7.9	8.5	7.7	6.4
	Min.	3.4	3.8	5.2	2.2	1.3	4.4	3.1	2.3	0.7	79.2	3.3	1.8	6	6.0	-0.2	-	-	4.4	1.5	3.0	2.6	2.1	3.4
	N	44	2	2	2	11	4	9	26	10	2	6	5	3	3	6	1	1	3	11	13	15	24	6
	females																							
	mean	3.6	0.6	-	2.6	1.8	1.0	0.6	1.4	1.2	0.9	1.6	4.0	3.0	2.4	3.6	-	1.6	2.0	2.3	0.7	2.0	1.8	2.8
	±S.D.	1.28	1.73	-	-	2.65	1.62	0.84	1.48	0.64	-	1.20	-	0.70	1.74	0.66	-	0.86	2.51	1.58	0.93	1.85	1.78	2.40
	Max.	6.1	2.8	-	-	4.5	3.2	2.0	4.2	1.6	-	2.5	-	3.5	4.3	4.1	-	2.9	4.4	5.2	1.7	4.6	6.3	4.5
	Min.	1.4	-1.4	-	-	-0.8	-0.6	-0.4	-0.6	0.7	-	0.8	-	2.5	-1.0	2.6	-	0.9	-0.6	0.6	-0.3	-0.6	-1.1	1.1
	N	20	5	-	1	3	4	6	12	2	1	2	1	2	9	4	-	4	3	9	4	7	19	2

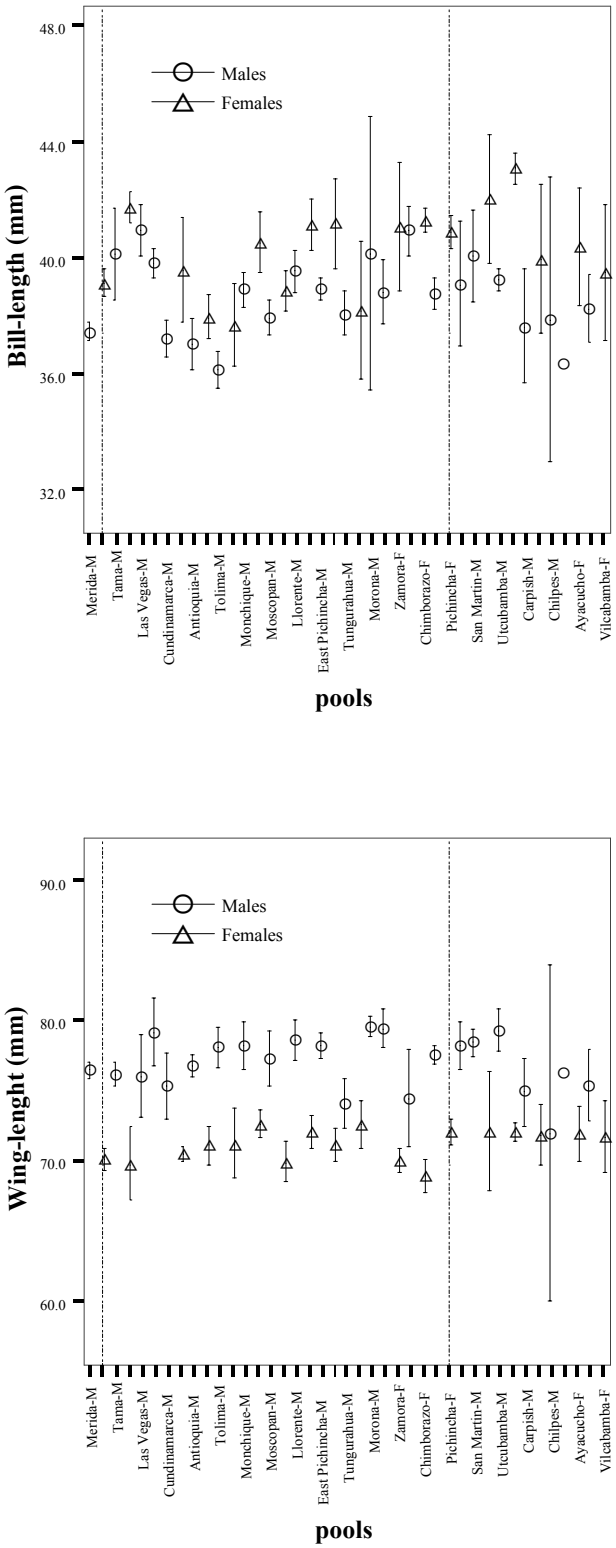


Figure 2.3.3. Geographic variation of the bill and wing-length in the superspecies complex *C. torquata*. The circles and triangles represent the arithmetic mean in males and females, respectively; the vertical solid lines the standard error of the mean; the dashed lines represent the pool groups for each allospecies, from left to right: *C. conradii*, *C. torquata* , and *C. insectivora*.

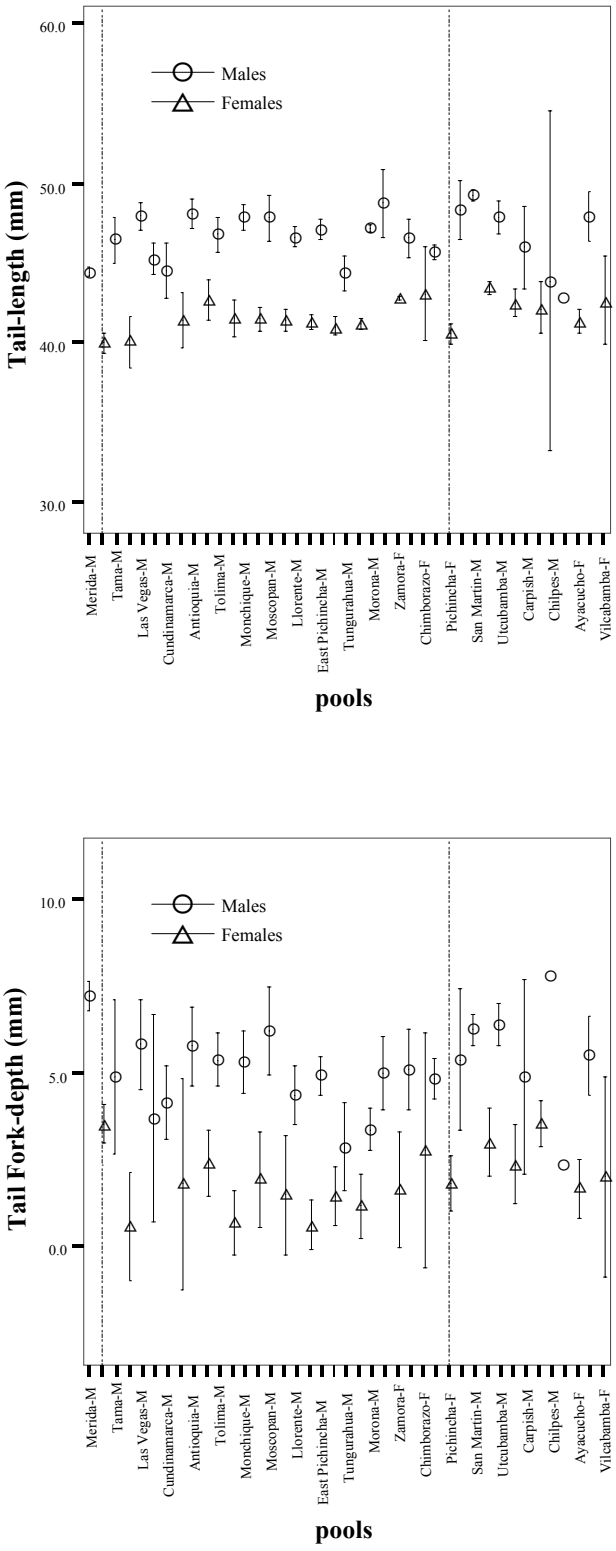


Figure 2.3.4. Geographic variation of the tail-length and tail fork-depth in the superspecies complex *C. torquata*. The circles and triangles represent the arithmetic mean in males and females, respectively; the vertical solid lines the standard error of the mean; the dashed lines represent the pool groups for each allospecies, from left to right: *C. conradii*, *C. torquata* , and *C. insectivora*.

1.4 *Coeligena bonapartei* (Boissonneau, 1840)

1.4.1 Geographic distribution and taxonomy

Coeligena bonapartei occupies a relatively small geographic range, occurring in a patchy pattern on the Sierra de Perija, along the Colombian-Venezuelan border, in the East Andes of central Colombia, and with only one record from the Paramo de Frontino, in the northern Central Andes of Colombia. Three subspecies have been recognised: *C. b. consita*, in the Sierra de Perija, along the border of Venezuela and Colombia; *C. b. bonapartei*, on the western slope of the East Andes of Colombia, between Boyacá and Bogotá; *C. b. orina*, only known from the Páramo of Frontino, in Antioquia, northern central Colombia (Schuchmann 1999).

The species was first described by Boissoneau (1840) as *Ornismia Bonapartei*, its origin being assigned to Santa Fe de Bogotá and later placed in the genus *Helianthea* Gould, 1848 by Bonaparte (1850), there were no changes in the species' taxonomy until Peters' (1945) check-list, which included it in the genus *Coeligena*, Lesson 1832.

Wetmore & Phelps (1952) described the race *Coeligena bonapartei consita*, from the Perija Mountains of Venezuela and Colombia, and later Wetmore (1953) described the species *Coeligena orina*, from the Paramo Frontino, Antioquia, in the northwestern Colombian Andes, only known from the holotype (deposited in the National Museum of Natural History, Washington, D.C.). The taxon was considered by Bleiweiss (1988b) to be a subspecies of *Coeligena bonapartei* (Boissonneau, 1840), bringing to three the number of currently recognised subspecies: *C. b.consita*, *C. b. bonapartei* and *C. b. orina* (Fjeldså & Krabbe 1990, Schuchmann 1999).

1.4.2 Diagnosis

Coeligena bonapartei is sexually dimorphic. Males have a long black bill; head black with a slightly bluish green iridescent frontlet; upperparts shining dark Parrot Green 160, more golden Spectrum Orange 17 on lower back; upper tail-coverts metallic dark golden bronze. The throat is glittering dark Emerald Green 163 with a bluish iridescent Spectrum Violet 72 patch; belly golden; under tail-coverts golden Olive-Green 47 fringed rufous; tail forked, dark golden Olive-Green 47. The females are similar to males, with longer bills; head Parrot Green 160; chin and throat rufous Amber 36 with some metallic green discs; underparts rufous Amber 36 with large green discs; belly golden; under tail-coverts bronzy olive green, largely

fringed rufous Amber 36; tail less forked, golden-yellowish Olive-Green 50, sometimes buff on tips. Immature resembles adult female.

1.4.3 Geographic variation analysis

A total of 28 specimens of *Coeligena bonapartei* (16 males, 10 females and 2 immatures) were analysed. Only 39% of the skins was of analytical value, due to the absence of precise information on the collecting sites or origin of the specimen (many of them are catalogued as 'Bogotá skin trade' or 'Colombia'). Specimens with 'good' data were grouped into the following three geographic pools:

1. Perija: located on the border between Colombia and Venezuela, in the Perija Mountains, between 1800 and 3000 m a.s.l.

2. Cundinamarca: located on the western slopes of the East Andes of central Colombia, between 2500 and 3200 m.

3. Frontino: located in the Paramo Frontino, in the West Andes of northwestern Colombia, at 3890 m. Exceptional pool formed by only one specimen.

1.4.3.1 Morphometric variation

Males of *Coeligena bonapartei* have shorter bills, longer wings and longer and more deeply forked tails than females (Tab. 2.4.1). In males, no significant differences between the pools was found (Fig. 2.4.3-4); nevertheless, the only male from the Perija pool (wing-length: 78.6 mm; tail-length: 50.4) had wings and tail longer than the males from the Cundinamarca and Frontino pools (wing-length: 72.0-73.3 mm; tail-length: 44.3-45.3 mm). The female sample size did not allow statistical comparisons.

1.4.3.2 Plumage variation

The male from the pool Perija (1) exhibited a black head with a metallic Apple Green 61 frontal patch; nape black; upperparts and upper tail-coverts very bronzy dark Parrot Green 160. The chin is metallic Apple Green 61; throat yellowish Spectrum Green 62; gular patch very bluish True Violet 172A; underparts glittering reddish bronze; under tail-coverts Olive-Green 50 tipped Cinnamon 39. The rectrices are very bronzy Olive-Green 50; wing-coverts like back; primaries Raw Umber 223; secondaries Cinnamon 39. The females are similar to the males; the frontal patch is absent; nape like the head; upperparts lighter, more mixed with

green. The chin and throat are pale Cinnamon 39, with tiny metallic yellowish Parrot Green 260 discs; underparts more mixed with yellowish green. The rectrices are bronze Olive-Green 50, outer feather border white, the rest tipped white.

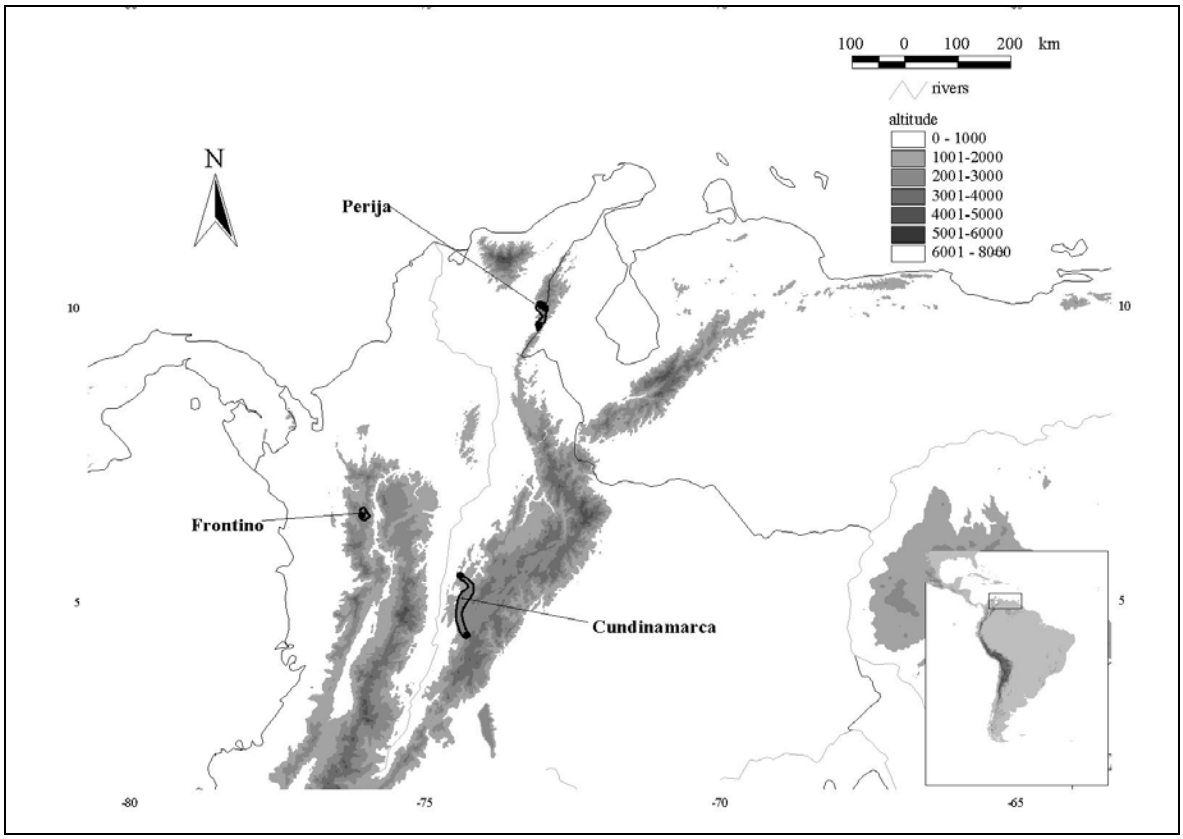


Figure 2.4.1. Geographic distribution of *C. bonapartei*. The polygons represent the geographic pools, dots the localities.

The males from the Cundinamarca pool (2) present an appearance similar to that described above for the Perija pool, differing in the more blackish coloration on the head; nape and upper back glittering dark Parrot Green 160 fringed golden; lower back and upper tail-coverts metallic golden olive Spectrum Orange 17. The chin and throat are bluish dark Parrot Green 160; gular patch True Violet 172A; underparts like throat; belly golden Spectrum Orange 17 mixed with some olive; under tail-coverts light Olive-Green 50 bordered Cinnamon 39. The rectrices are Olive-Green 50; Remiges Raw Umber 223. The only specimen from El Peñon, above Fusagasuga, at the northern extreme of the pool, has the inner base of the secondaries Cinnamon 39. No females were found in this pool.

The Frontino pool is formed by only one male specimen, probably an immature (presence of groove on the gnathotheca, after Ortiz-Crespo 1972) that shares many similarities with the

males from pool 2, being much blacker on the head, upperparts and underparts; the lower back and belly more yellowish Parrot Green 160; all remiges Raw Umber 223.

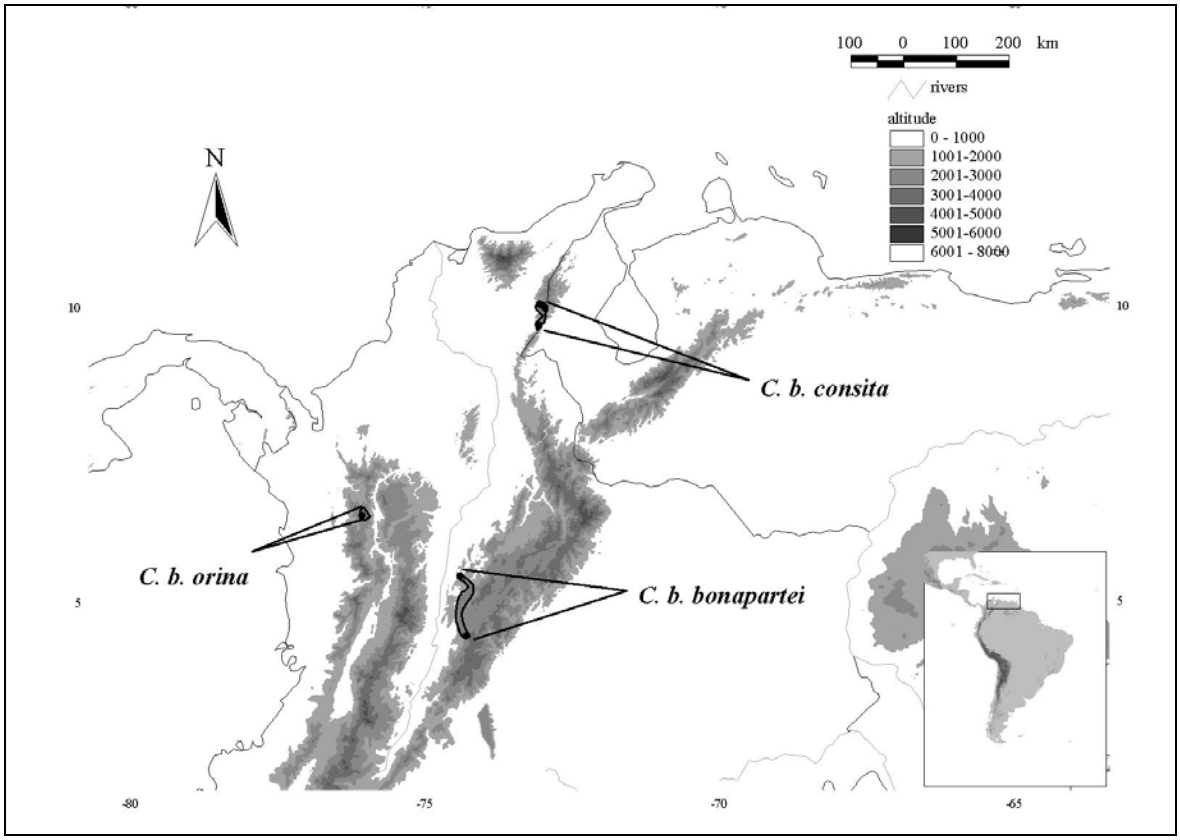


Figure 2.4.2. Geographic distribution of *C. bonapartei* with the range of each subspecies indicated by polygons.

The specimens from Perija pool correspond with the subspecies *Coeligena bonapartei consita* (Wetmore and Phelps, Jr., 1952), which was described for the first time only from adult females. Only one male specimen was found in all the museums visited, which is deposited in the Colección Ornitológica Phelps, in Caracas. The taxon is distinguishable by the pale brown coloration on the secondaries, sharing this character with the species *Coeligena eos*, from the Venezuelan Andes, with the rest of the body coloration being similar to the nominate race (Fig. 2.4.2).

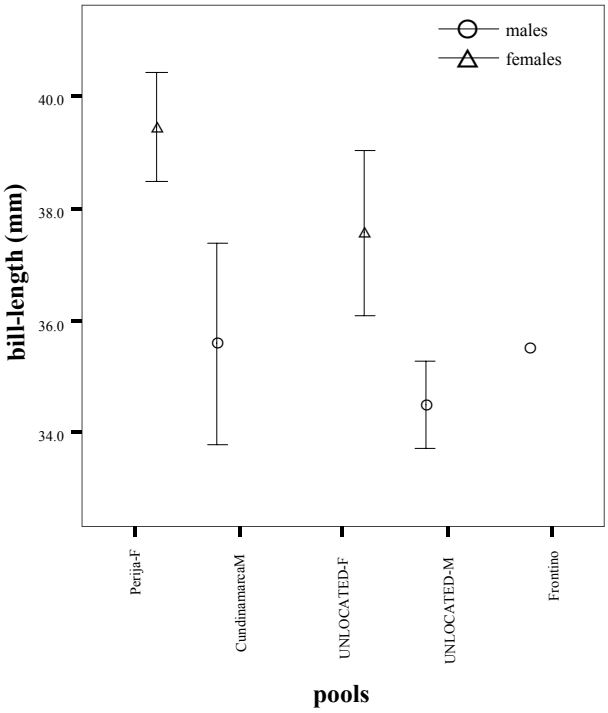
The Cundinamara pool corresponds with the nominate race, *C. b. bonapartei* (Boissonneau, 1840). The majority of the 'Bogota'-labelled males show the same coloration pattern as observed for males from the Cundinamarca pool. As mentioned, there were no females that could be assigned to this pool. Considering that the northern race *C. b. consita* was described much later than the nominate subspecies, it is plausible that all those older females specimens

labelled ‘Bogota’ belong to this pool. These ‘Bogota’ females are similar to females from Perija, except for the absence of the cinnamon spot on the secondaries and their tendency to be smaller in size (Fig. 2.4.3-4).

The Frontino pool (3) is represented by only one immature male that lacks the metallic green frontal spot and the pale brown spot on the secondaries. The specimen was described as *Coeligena orina* Wetmore, 1953 and recently Bleiweiss (1988), based on non age-related distinctive plumage features, considered the holotype as the immature male of a *C. bonapartei* subspecies different from *C. b. bonapartei* and *C. b. consita*. On this assumption, the name *Coeligena bonapartei orina* (Wetmore, 1953) has been assigned to the population occurring in the Paramo Frontino (Fjeldså & Krabbe 1990, Schuchmann 1999). Nevertheless, there are authors who prefer to consider the taxon as a valid species (e.g., Hilty & Brown 1986). In this study, the taxon is considered as a subspecies of *C. bonapartei*, but adult specimens of both sexes are still necessary to clarify the taxonomic and systematic status of the group.

Table 2.4.1. Descriptive statistics of the morphometric parameters of *C. bonapartei*. Pools are ordered geographically from north to south.

Mophometric parameters	**Pools**	Perija	Cundinamarca	Unlocated	Frontino
bill-length (mm)	males				
	mean	-	35.6	34.5	35.5
	±S.D.	-	1.27	1.36	-
	Max.	-	36.5	34.5	-
	Min.	-	34.7	32.5	-
	N	-	2	12	1
	females				
	mean	39.4	-	37.6	-
	±S.D.	1.19	-	1.46	-
	Max.	40.6	-	39.1	-
	Min.	37.6	-	36.0	-
	N	6	-	4	-
wing-length (mm)	males				
	mean	78.6	73.3	70.4	72.0
	±S.D.	-	1.56	4.37	-
	Max.	-	74.4	70.4	-
	Min.	-	72.2	62.7	-
	N	1	2	12	1
	females				
	mean	72.6	-	67.1	-
	±S.D.	1.40	-	3.02	-
	Max.	74.1	-	70.6	-
	Min.	70.7	-	63.3	-
	N	6	-	5	-
tail-length (mm)	males				
	mean	50.4	44.3	44.8	45.3
	±S.D.	-	0.70	1.86	-
	Max.	-	44.8	44.8	-
	Min.	-	43.8	40.1	-
	N	1	2	12	1
	females				
	mean	44.8	-	41.9	-
	±S.D.	1.02	-	1.79	-
	Max.	46.1	-	44.3	-
	Min.	43.9	-	39.7	-
	N	6	-	5	-
tail fork-depth (mm)	males				
	mean	-	9.9	8.3	6.5
	±S.D.	-	-	1.85	-
	Max.	-	-	8.3	-
	Min.	-	-	5.4	-
	N	-	1	12	1
	females				
	mean	7.0	-	4.7	-
	±S.D.	1.70	-	2.24	-
	Max.	8.2	-	7.2	-
	Min.	5.8	-	1.5	-
	N	2	-	5	-



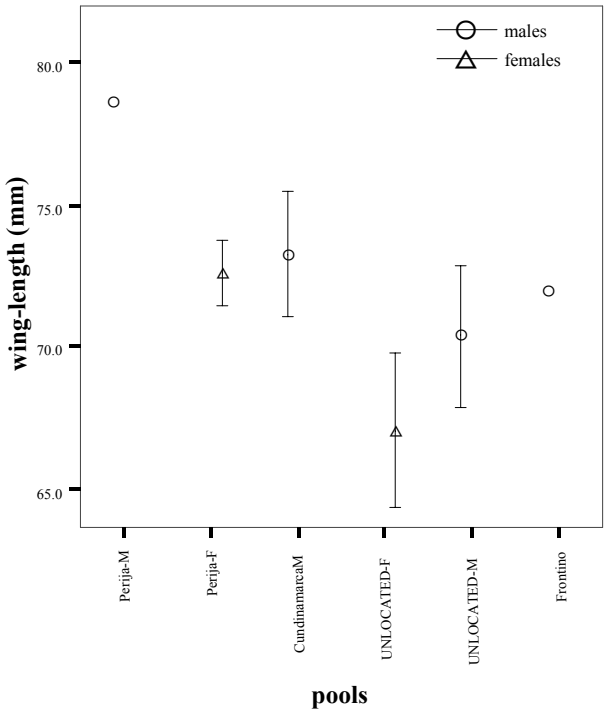
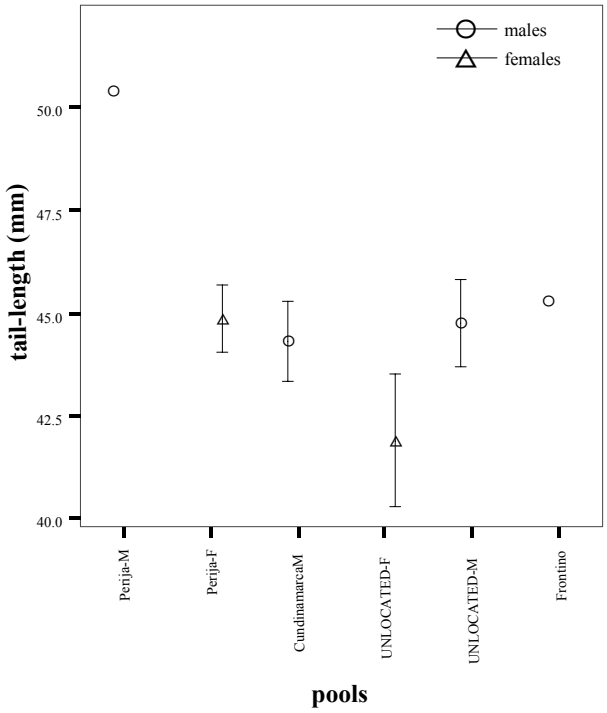


Figure 2.4.3. Geographical variation of the bill- and wing-lengths in *C. bonapartei*. The circle and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. Pools are ordered from north to south. The group with the name 'Unlocated' is linked to the Cundinamarca pool (see text).



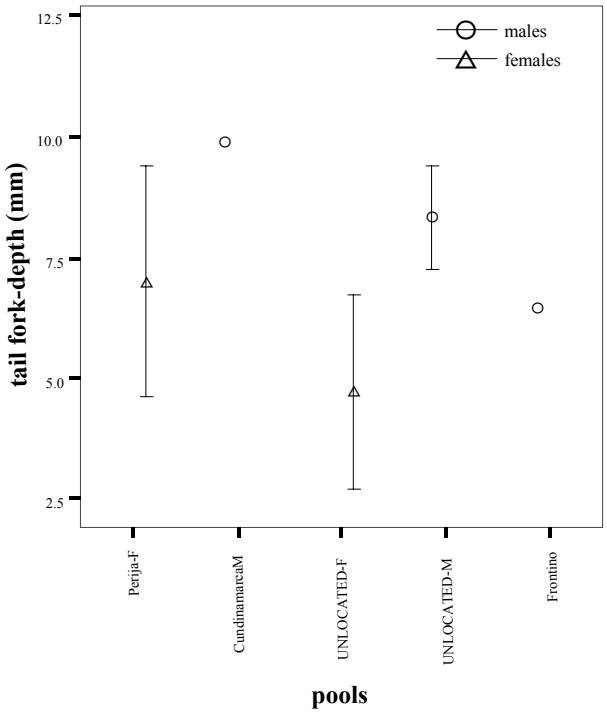


Figure 2.4.4. Geographical variation of the tail-length and the tail fork-depth in *C. bonapartei*. The circle and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. Pools are ordered from north to south. The group with the name 'Unlocated' is linked to Cundinamarca pool (see text).

1.5 *Coeligena eos* (Gould, 1848)

1.5.1 Geographic distribution and taxonomy

Coeligena eos is a monotypic species endemic to the high Venezuelan Andes, above 2500 m altitude, and not recorded for northeastern Colombia (Chapman 1917, Hilty & Brown 1986).

The species was first described by Gould in 1848 as *Helianthea Eos*, from the highlands of 'New Granada' (Colombia) and Venezuela. This species name was maintained in studies by several authors (Berlioz 1936; Bonaparte 1850; Elliot 1874, 1878; Gould 1861; Hartert 1900; Reichenbach 1853; Simon 1910).

Peters (1945) presented the taxon as a valid species of *Coeligena* Lesson, 1832 in his check-list of the birds of the world, and regarded the locality 'New Granada' as an error, restricting the distribution to Venezuela. This is currently accepted (Olrog 1968, Schuchmann 1999), but some authors adopted Meyer de Schauensee's (1966) work considering the taxa a subspecies of *Coeligena bonapartei* (Phelps & Phelps 1958, Fjeldså & Krabbe, 1990, Meyer de Schauensee & Phelps 1978).

1.5.2 Diagnosis

Coeligena eos is sexually dimorphic, with males having a black bill; head black with a greenish sheen; frontal spot metallic bluish Spectrum Green 62; nape and upper back Parrot Green 260; lower back and upper tail-coverts golden bronzy Parrot Green 160. The chin is bluish Dark Green 262; throat turquoise-yellowish Spectrum Green 62 with metallic Spectrum Violet 72 gular spot; underparts like throat; belly metallic golden Spectrum Orange 17 fringed pale Tawny 38; under tail-coverts Cinnamon 39. The rectrices are Tawny 38; with the inner feathers half golden Olive-Green 46 and the outer with decreasing olive tipping; wing-coverts like the back; primaries dark Raw Umber 23 with the border of the outer feather Tawny 38; secondaries Tawny 38 tipped dark Raw Umber 23. The females are similar to the males, with head, nape and upper back bluish Parrot Green 169; lower back golden Parrot Green 160. The chin and throat are Cinnamon 39 with metallic Parrot Green 160 discs; underparts glittering Parrot Green 160 mottled Cinnamon 39; belly metallic bronzy Spectrum Orange 17 mottled Cinnamon 39. The rest like male coloration.

1.5.3 Geographic variation analysis

A total of 30 males and 10 females specimens of *Coeligena eos* was analysed. The specimens with reliable collecting site came from the same region, so it was only possible to group them in one single geographic pool: Merida.

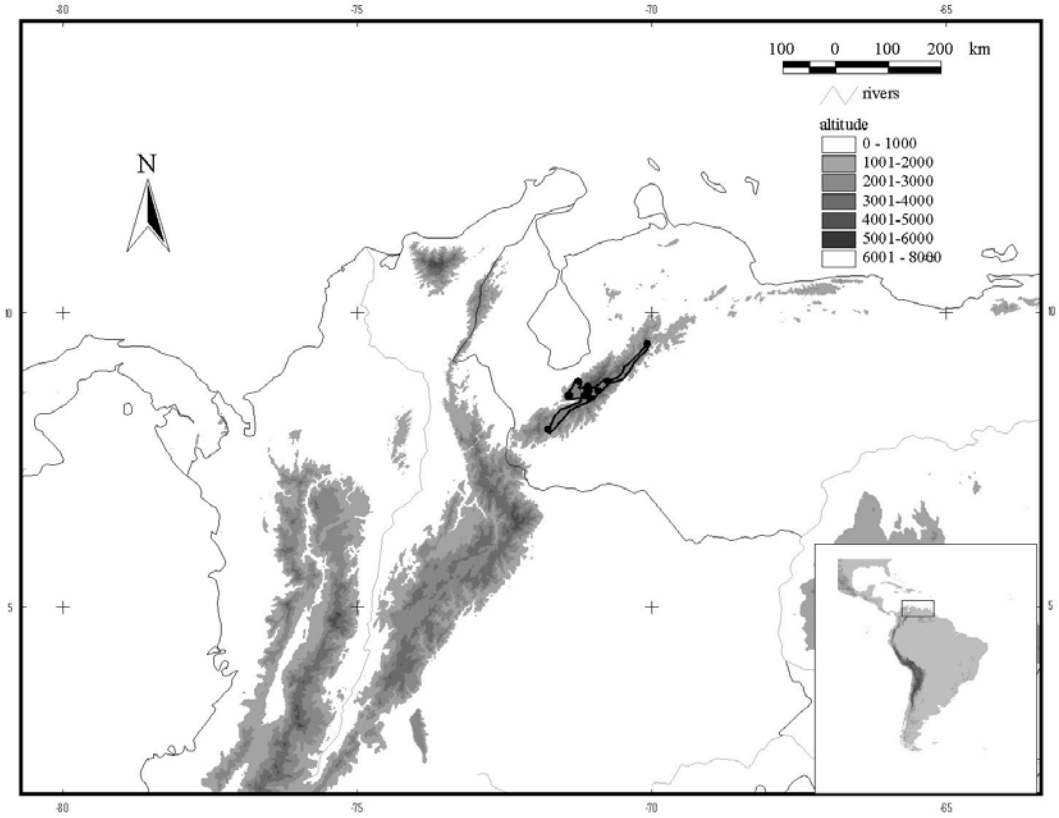


Figure 2.5.1. Geographic distribution of *C. eos.* The polygon represents the range of the species, dots represent the localities.

1.5.3.1 Morphometric variation

Coeligena eos shows morphometric sexual dimorphism, with males having shorter bills, longer wings, and longer and more deeply forked tails than females. No significant differences were found within the sexes (Tab. 2.5.1, Fig. 2.5.2).

1.5.3.2 Plumage variation

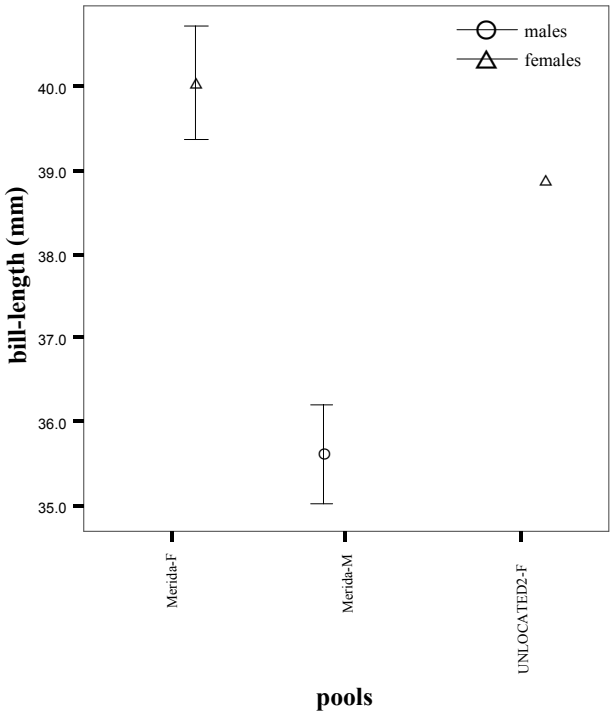
No geographic variation was found within the pool, the males having a black head very mixed with Dark Green 262; frontal spot metallic bluish Spectrum Green 62; nape and upper back golden Parrot Green 160 becoming more golden towards the lower back;

Table 2.5.1. Descriptive statistics of *Coeligena eos*. The first line represents the parameter mean values, the two other lines the range and the sample sizes.

Sex	bill-length (mm)	wing-length (mm)	tail-length (mm)	tail fork-depth (mm)
males	35.7±1.68 40.0-33.8 n=22	71.6±2.10 74.3-66.5 n=22	43.8±2.30 46.8-38.4 n=22	6.8±2.96 11.0- -1.5 n=22
females	40.0±1.00 41.4-38.5 n=8	67.8±1.22 69.7-65.7 n=8	40.7±1.46 43.0-38.7 n=8	3.5±0.82 4.3-2.1 n=8

lower back and upper tail-coverts glittering orange Olive-Green 50. The chin is metallic Dark Green 162A; throat glittering bluish Spectrum Green 62 with well-developed metallic Spectrum Violet 72 gular patch; underparts glittering bluish Spectrum Green 62; belly metallic golden Spectrum Orange 17; under tail-coverts Amber 36. The rectrices are Amber 36 tipped golden-yellowish Olive-Green 50, the innermost rectrix with terminal half Olive-Green 50; wing-coverts like upper back; primaries Raw Umber 223, innermost feather with border pale Cinnamon 39; secondaries Amber 36 tipped Raw Umber 223. The females are similar to males, with head, nape and upper back glittering dark Parrot Green 160; lower back and under tail-coverts like males. The chin and throat are Cinnamon 39 with scaly metallic dark Parrot Green 260 in tiny discs; underparts golden Olive-Green 50 mottled Cinnamon 39; belly like males, mixed with golden Olive-Green 50 mottled Cinnamon 39; remainder like males.

The phylogenetic relationships of this species to other members of the genus *Coeligena* will be treated in the next chapter.



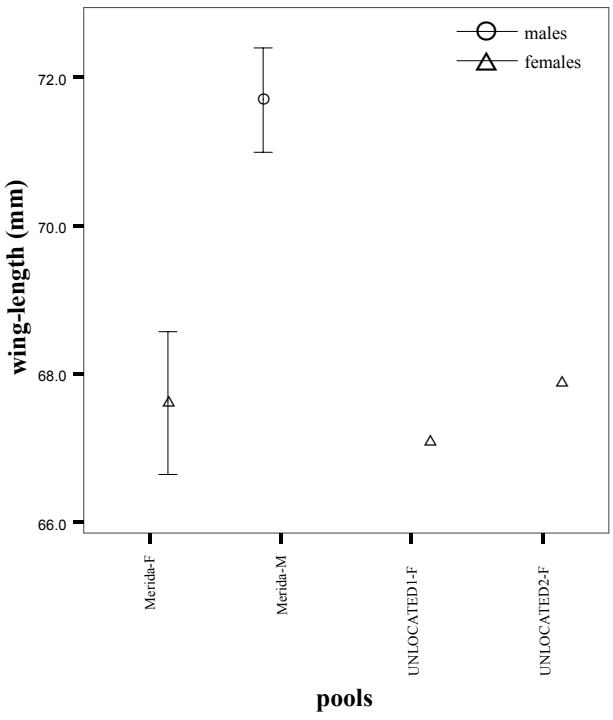
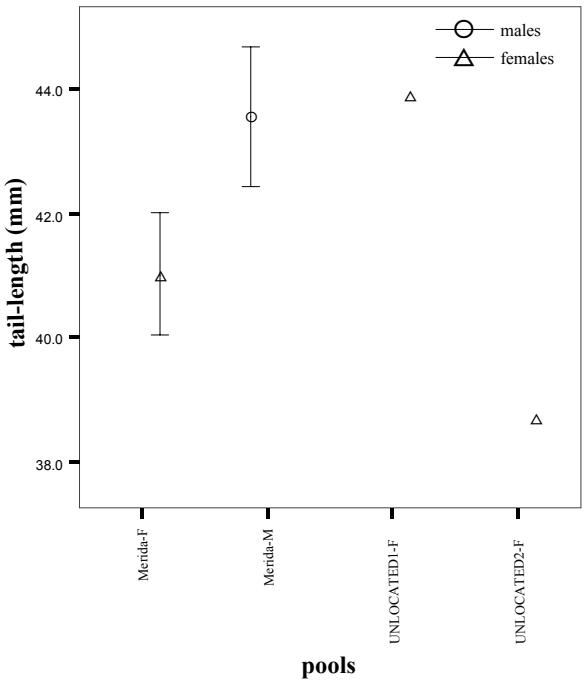


Figure 2.5.2. Geographic variation of the bill- and wing-length of *C. eos*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. Pools are ordered from north to south (see text for details about the unlocated localities).



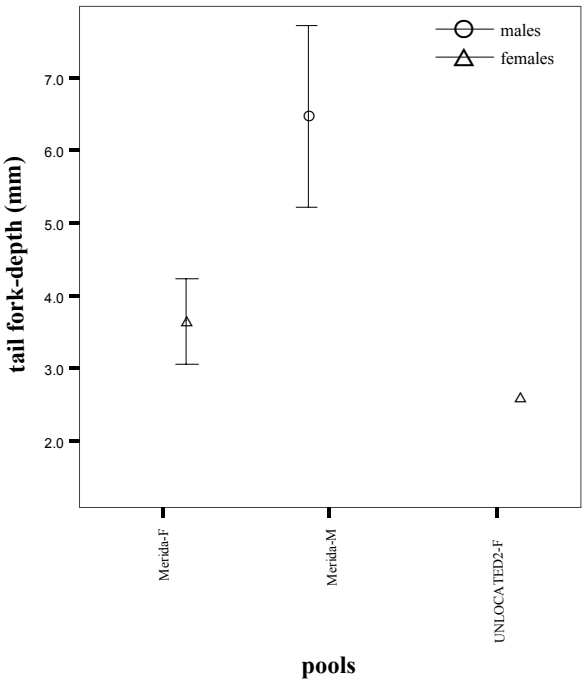


Figure 2.5.3. Geographic variation of the tail-length and the tail fork-depth of *C. eos*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. Pools are ordered from north to south (see text for details about the unlocated localities).

1.6 *Coeligena helianthea* (Lesson, 1838)

1.6.1 Geographic distribution and taxonomy

Coeligena helianthea has a very restricted distribution area, being one isolated population confined to the high Venezuelan Andes, in the paramo Tamá (subspecies *C. h. tamai*), and on the border of Venezuela and Colombia to the Colombian East Andes, from Santander to Cundinamarca (the nominate subspecies;. Fjeldså & Krabbe 1990, Hilty & Brown 1986, Schuchmann 1999).

The taxon was described for the first time by Lesson in 1838 with a specimen from 'Santa Fe de Bogota' collected by Parzudaki (without date), and named *Ornismya helianthea*. Gould (1848) erected the genus *Helianthea* with this species as type, giving to it the name *Helianthea typica*, as synonym for *Ornismya helianthea* Lesson, 1838. This new name was considered valid by several authors (Bonaparte 1850; Elliot 1874, 1878; Gould 1861, Reichenbach 1853), until Hartert (1900), who introduced Lesson's (1838) original name: *Helianthea helianthea* (Lesson, 1838). This name became the valid name for several authors (Berlioz 1936, Chapman 1917, Simon 1921).

In his taxonomic changes, Peters (1945) listed the species under the genus *Coeligena* Lesson, 1832. Berlioz & Phelps (1953) described the subspecies *Coeligena helianthea tamai* with a series containing males and females collected by Phelps in 1941 in the paramo de Tamá, Venezuela. In the current classification of *Coeligena helianthea* (Lesson, 1838) two subspecies are considered valid.

1.6.2 Diagnosis

Coeligena helianthea is sexually dimorphic, with males having a black bill; black head with a metallic bluish Spectrum Green 62 frontal spot; nape black; upper back Dark Green 262; lower back and upper tail-coverts with a mixture of metallic Cyan 164, Ultramarine 270 and bluish True Violet 172. The chin and throat are black with a metallic Spectrum Violet 72 gular patch; underparts Dark Green 262, belly and under tail-coverts purplish-blackish Pink 7. The rectrices are dark Greenish-Olive 49; wing-coverts like upper back; remiges Raw Umber 223. The females are similar to males, with the head Parrot Green 160, lacking the frontal spot; chin and upper throat dull Amber 36; lower throat metallic Spectrum Green 62; remainder of plumage like males. Immatures are similar to adult females.

1.6.3 Geographic variation analysis

A total of 25 males and 14 females of *Coeligena helianthea* was studied. Only the specimens with reliable geographic information (*c.* 49%) were grouped into the following geographic pools:

1. Tama: located in the Paramo de Tamá, in the East Andes on the border between Venezuela and Colombia, between 1800 and 2800 m a.s.l.

2. Santander: located in the region of Santander, on the western slopes of the north Colombian East Andes, between 1000 and 3000 m.

3. Cundinamarca: located in the surroundings of Bogotá, on the western slopes of the East Andes of central Colombia, between 1600 and 2700 m.

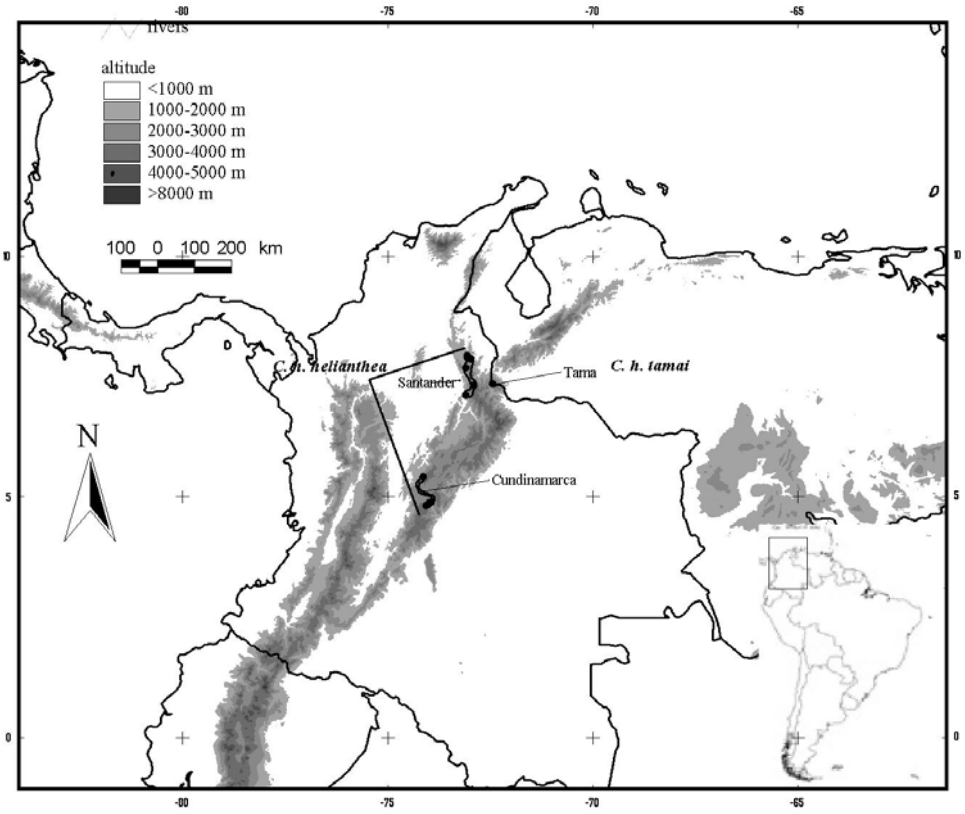


Figure 2.6.1. Geographic distribution of *C. helianthea*. The polygons represent the geographic pools, the dots the localities. The subspecies ranges are also indicated.

1.6.3.1 Morphometric variation

Coeligena helianthea shows morphometric sexual dimorphism, the males having shorter bills, longer wings and longer and more forked tails than the females (Tab. 2.6.1). Low significant

differences were found between pools (Fig. 2.6.2-3), specimens from the Cundinamarca pool (3) having a tendency to be smaller than the remaining pools (see Tab. 2.6.1), the only statistically significant differences being in wing-length ($p<0.01$; Cundinamarca males: 70.1±1.27 mm; other males: 74.2-75.1 mm).

1.6.3.2 Plumage variation

The Tama pool (1) forms one unit, distinguishable from the two other Colombian pools in males having a black head with a metallic Spectrum Green 62 frontal patch; nape black; upper back very blackish Dark Green 262; lower back and upper tail-coverts metallic Cyan 164-Cobalt Blue 168. The chin and throat are very Dark Green 262, with a very bluish Spectrum Violet 72 gular patch; underparts blackish Dark Green 262; upper belly metallic Rose 9; under tail-coverts True Violet 172 tipped dark purplish Smalt Blue 70. The rectrices are Greenish Olive 49. The females are similar to the males, with less black on the head; lower back less glittering; chin and throat completely reddish Clay Color 123B; underparts mottled with Clay Color 123B; under tail-coverts purplish Clay Color 123B; the remainder is similar to males.

1.6.4 Discussion

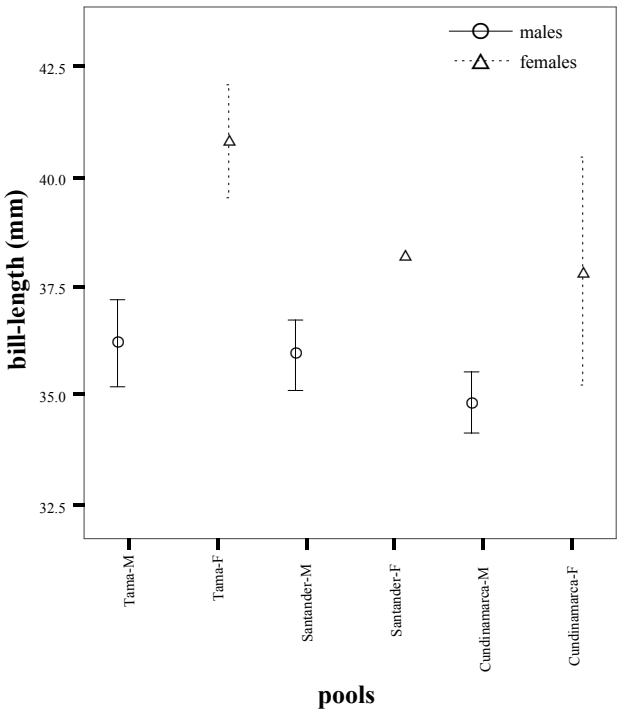
The Santander and Cundinamarca pools (2 and 3) show specimens with almost no variation in their coloration pattern. They differ in some aspects from the Tama pool males in being less blackish on the upper back and with the gular patch more violet than bluish. The most striking difference found is the absence of blue in the under tail-coverts. The females from the Colombian pool group are also very similar to the Tama females, differing in the less reddish, rather yellowish hue on the chin and throat.

The Tama pool corresponds with the subspecies *C. h. tamai* Berlioz & Phelps, 1953, restricted to the Paramo de Tama and distinguishable by the more bluish hue on the underparts in males and females; by the blue tipping on the males under tail-coverts and by the more reddish ochre coloration on the female chin and throat. This population forms an isolated distinct unit (Fig. 2.6.1).

The Colombian pool group on the western slopes of the East Andes corresponds with the nominate form *C. h. helianthea* (Lesson, 1838) which forms a homogeneous unit separated from the Tama population and well differentiated (Fig. 2.6.1).

Table 2.6.1. Descriptive statistics of the morphometric parameters in *C. helianthea*. The pools are ordered geographically from north to south.

Morphometric parameters	Pools	Tama	Santander	Cundinamarca
bill-length (mm)	males			
	mean	36.2	35.9	34.8
	±S.D.	0.70	0.70	0.70
	Max.	36.7	36.7	35.5
	Min.	35.7	35.3	34.0
	N	2	3	4
	females			
	mean	40.8	38.2	37.8
	±S.D.	1.12	-	2.92
	Max.	42.1	-	42.1
	Min.	40.1	-	34.9
	N	3	1	5
wing-length (mm)	males			
	mean	75.1	74.2	70.1
	±S.D.	1.13	0.50	1.27
	Max.	75.9	74.9	71.8
	Min.	74.3	73.6	68.8
	N	2	5	4
	females			
	mean	70.4	68.8	67.2
	±S.D.	0.42	-	2.10
	Max.	70.7	-	69.0
	Min.	70.1	-	64.3
	N	2	1	5
tail-length (mm)	males			
	mean	47.9	45.6	45.4
	±S.D.	1.70	4.28	1.81
	Max.	49.1	49.0	47.6
	Min.	46.7	39.4	43.6
	N	2	4	4
	females			
	mean	40.4	42.0	41.6
	±S.D.	1.27	-	1.85
	Max.	41.3	-	43.8
	Min.	39.5	-	39.4
	N	2	1	5
tail fork-depth (mm)	males			
	mean	11.1	9.1	9.6
	±S.D.	-	4.32	1.50
	Max.	-	12.4	11.1
	Min.	-	2.8	7.5
	N	1	4	4
	females			
	mean	4.6	7.4	4.6
	±S.D.	1.76	-	3.14
	Max.	5.9	-	9.3
	Min.	3.4	-	0.8
	N	2	1	5



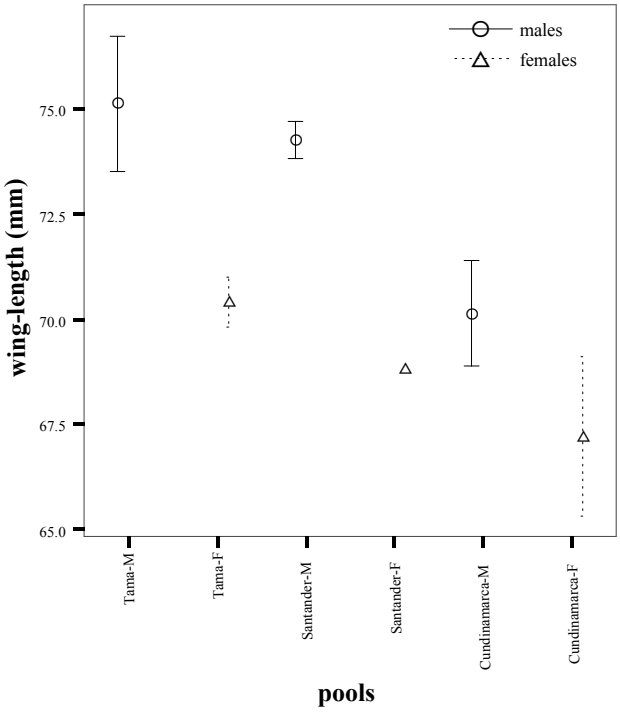
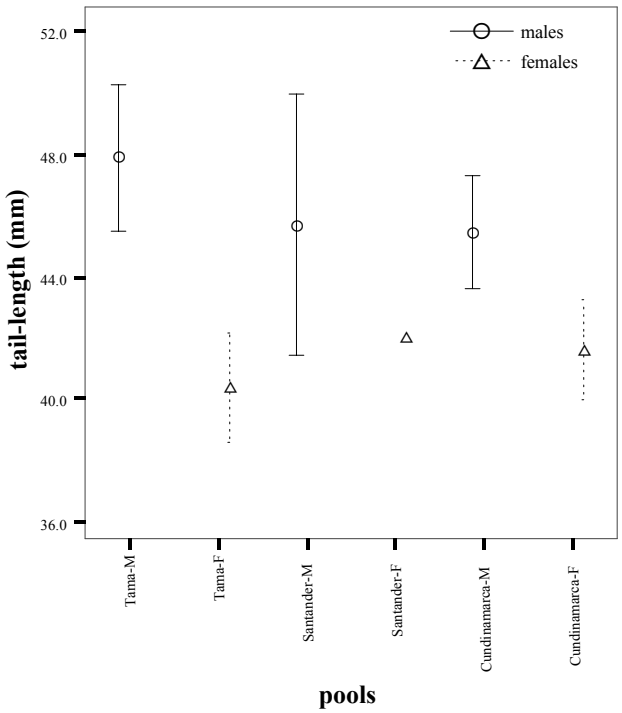


Figure 2.6.2. Geographic variation of the bill- and wing-length in *C. helianthea*. The circles and triangles represent the arithmetic mean in males and females, respectively; and vertical lines the standard error of the mean. Pools are ordered geographically from north to south.



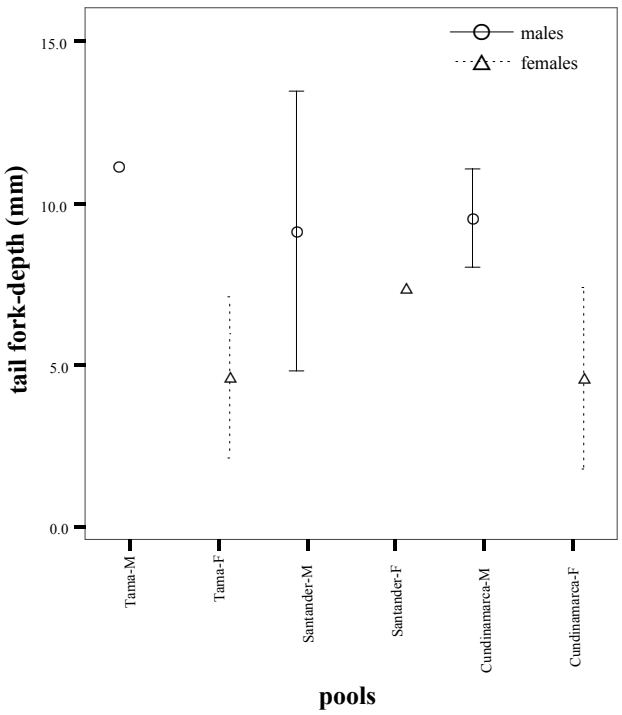


Figure 2.6.3. Geographic variation of the tail-length and the tail fork-depth in *C. helianthea*. The circles and triangles represent the arithmetic mean in males and females, respectively; and vertical lines the standard error of the mean. Pools are ordered geographically from north to south.

1.7 *Coeligena prunellei* (Bourcier, 1843)

1.7.1 Geographic distribution and taxonomy

Coeligena prunellei is a monotypic species that occurs on the western slopes of the East Andes in south-east Santander, Colombia, above 1600 m altitude. (Collar *et al* 1992, Schuchmann 1999). The species was first described by Bourcier (1843) as *Trochilus Prunellei*

The taxonomy of this taxon has been confusing, being problematic to classify due to its very particular coloration pattern. Bonaparte (1850) included the species in the genus *Bourcieria*, being later assigned by Reichenbach (1853) to the subgenus *Homophania*. Gould (1861) placed the taxon in the genus *Lampropygia* Reichenbach, 1853 as did Elliot (1876), who misspelled the specific epithet (‘*prunelli*’). Later (Elliot 1878) merged all the *Lampropygia* species into *Bourcieria* Bonaparte, 1850, the new name being *Bourcieria prunelli* (=*prunellei*) (Bourcier, 1843).

Hartert (1900) and later Berlioz (1936) agreed in considering the species a member of the genus *Helianthea* Gould, 1848, until Peters (1945), who listed the species as *Coeligena prunellei* (Bourcier 1843), this being the taxon’s name currently valid (Fjeldså & Krabbe 1990, Meyer de Schauensee 1966, Schuchmann 1999).

1.7.2 Diagnosis

Coeligena prunellei is a sexually monomorphic species, with a black bill; head bluish Greenish-Olive 49; nape very blackish Parrot Green 260 fringed with metallic Cobalt 68; upper back very blackish Parrot Green 260, fringed bluish Spectrum Violet turning less blackish on the lower back, fringed glittering yellowish Parrot Green 160; upper tail-coverts dull brownish True Violet 172. The underparts are blackish Sepia 219; throat scaly metallic purplish Cerulean Blue 67; chest with two conspicuous pure white spots on both sides; belly more brownish; under tail-coverts Sepia 219 bordered white. The rectrices purplish Sepia 219; lesser wing-coverts metallic Cobalt 68, greater wing-coverts like upper back; remiges Raw Umber 223, with the border of the outer primary pale Cinnamon 39. Immatures are similar to adults.

1.7.3. Geographic variation analysis

A total of 47 specimens of *Coeligena prunellei* (10 males, 17 females and 20 unsexed) was analysed. Approximately 47% of the specimens had reliable geographic information on the labels and were grouped into two geographical pools:

1. Virolín: located south of Bucaramanga, on the eastern bank of the River Sogamoso, on the western slopes of the Colombian East Andes, at 1800 m.

2. Pedropalo: located north of Bogotá, on the eastern bank of the River Magdalena, on the western slopes of the Colombian East Andes, between 2000 and 3200 m.

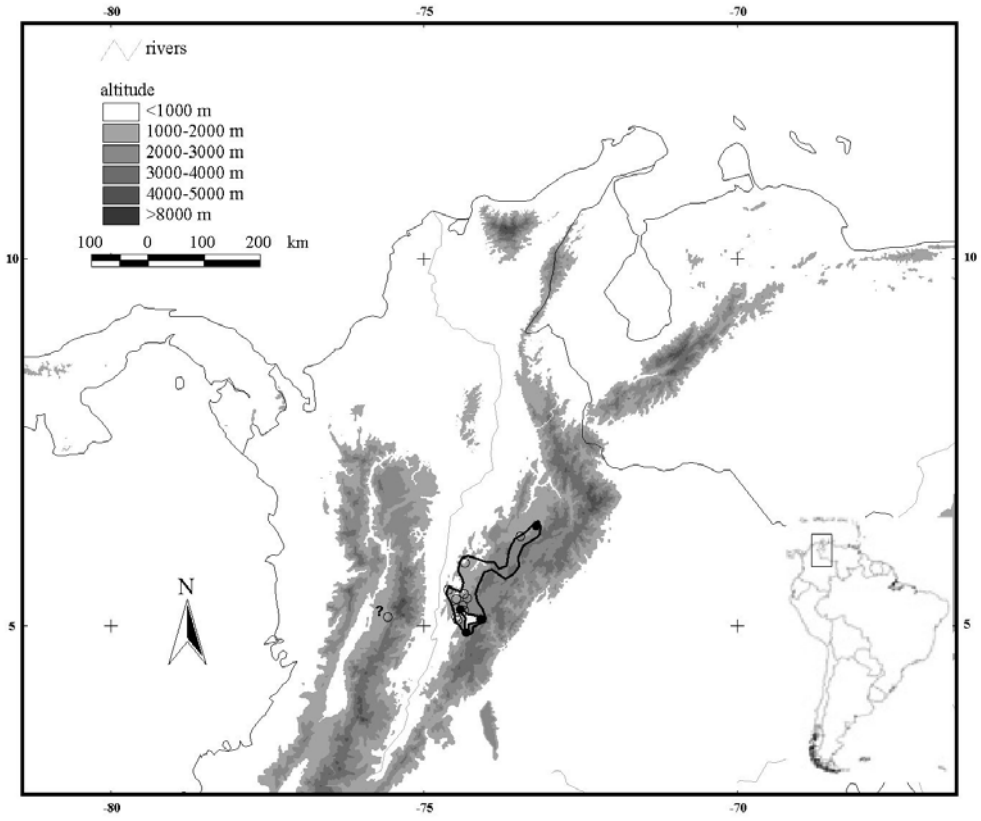


Figure2.7.1. Geographic distribution of *C. prunellei*. The solid dots represent the localities obtained from museum specimens, the open dots represent the localities from the literature (Collar *et al*. 1992). The filled polygon represents the only constructed geographic pool, the empty polygon represents the general distribution of the species.

Table 2.7.1. Descriptive statistics of the morphometric parameters in *C. prunellei.*

Morphometric parameters	Pools	Virolin	Pedropalo
bill-length (mm)	males		
	mean	32.2	31.9
	±S.D.	0.79	-
	Max.	33.1	-
	Min.	31.2	-
	N	4	1
	females		
	mean	33.6	32.8
	±S.D.	0.46	1.26
	Max.	34.1	35.4
	Min.	33.1	31.3
	N	5	11
wing-length (mm)	males		
	mean	77.1	75.5
	±S.D.	2.39	-
	Max.	78.6	-
	Min.	72.9	-
	N	5	1
	females		
	mean	71.2	74.8
	±S.D.	1.37	4.02
	Max.	73.3	81.1
	Min.	69.8	69.5
	N	5	11
tail-length (mm)	males		
	mean	50.7	51.3
	±S.D.	0.74	-
	Max.	51.5	-
	Min.	49.5	-
	N	5	1
	females		
	mean	42.9	48.4
	±S.D.	1.56	4.80
	Max.	45.2	56.4
	Min.	41.8	43.2
	N	4	9
tail fork-depth (mm)	males		
	mean	12.2	13.3
	±S.D.	0.68	-
	Max.	13.0	-
	Min.	11.5	-
	N	5	1
	females		
	mean	6.2	10.4
	±S.D.	1.62	3.70
	Max.	8.1	15.5
	Min.	4.7	5.3
	N	4	9

1.7.3.1 Morphometric variation

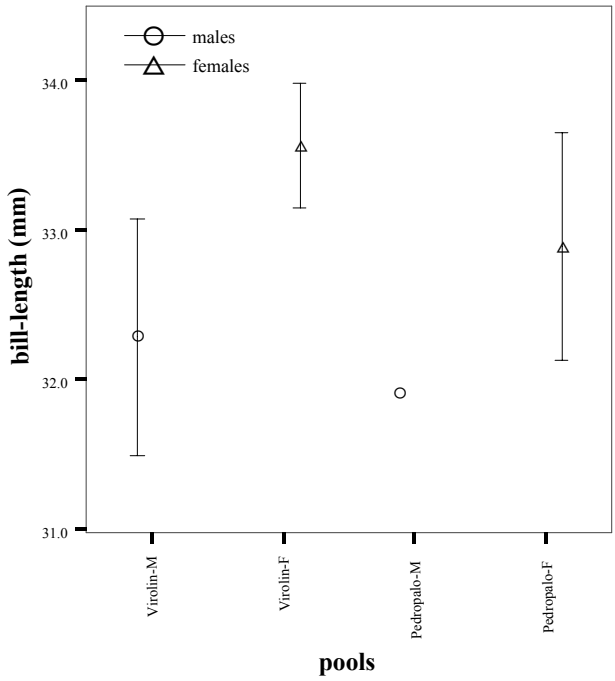
Sexual dimorphism showed statistical significace in morphometric parameters, with males having shorter bills, longer wings and longer and more deeply forked tails than females (Tab. 2.7.1; Fig. 2.7.2-3). Significant morphometric variation was only found in females between pools ($p<0.05$), revealing Virolin specimens with shorter and less forked tails (tail-length:

42.9±1.56 mm; tail fork-depth: 6.2±1.62 mm) than Pedropalo females (tail-length: 48.4±4,80 mm; tail fork-depth: 10.4±3.70 mm).

1.7.3.2 Plumage variation

No differences in coloration pattern were found between the pools, showing both sexes with fore and mid-head very dark Olive-Green 47; back head and nape black (with glittering bluish shine if seen from behind); upper back black (with glittering yellowish bronze and bluish shine if seen from behind); lower back black with glittering yellowish Spectrum Green 62; upper tail-coverts very dark bluish-purplish Fuscous 21. The chin is black; throat with scaly metallic yellowish Cerulean 68 patch on black background; underparts greyish black; chest with two white patches, one on each side; belly black fringed violet, white near the tail-coverts; under tail-coverts reddish dark Fuscous 21 bordered white. The tail feathers are violet-olive Sepia 219; lesser wing-coverts metallic Cobalt 68, greater wing-coverts dark olive Fuscous 21; remiges Raw Umber 223, outer primary border pale Cinnamon 39.

The *Coeligena prunellei* populations analysed constitute a homogeneous unit, slightly differentiated in the length and fork-depth of the tail but with no geographic differentiation in the coloration pattern; nevertheless, further research it is necessary, focusing on those populations that eventually would be or actually are presently outside the East Andes (see Collar *et al.* 1992) but no sample material has yet been collected (Fig. 2.7.1).



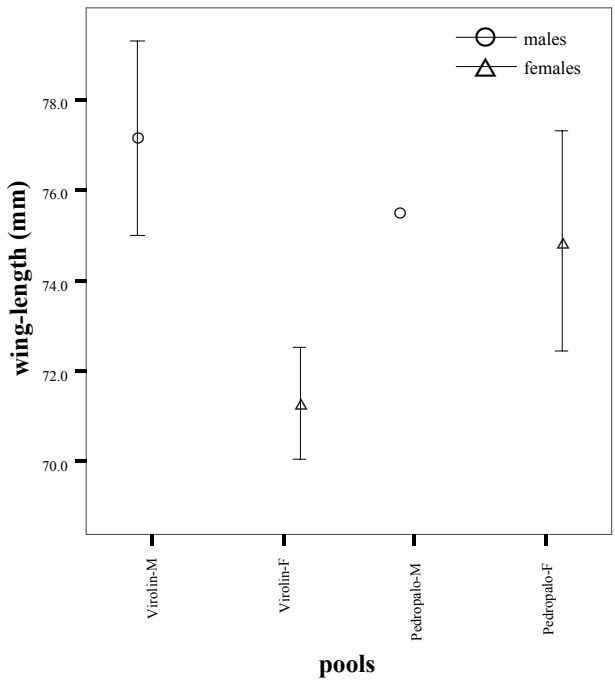
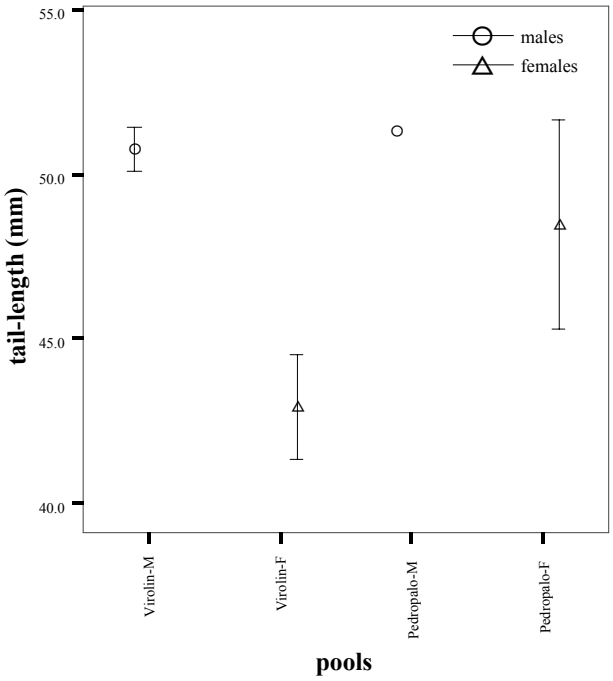


Figure 2.7.2. Geographic variation of the bill- and wing-length in *C. prunellei*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical line the standard error of the mean. Pools are ordered from north to south.



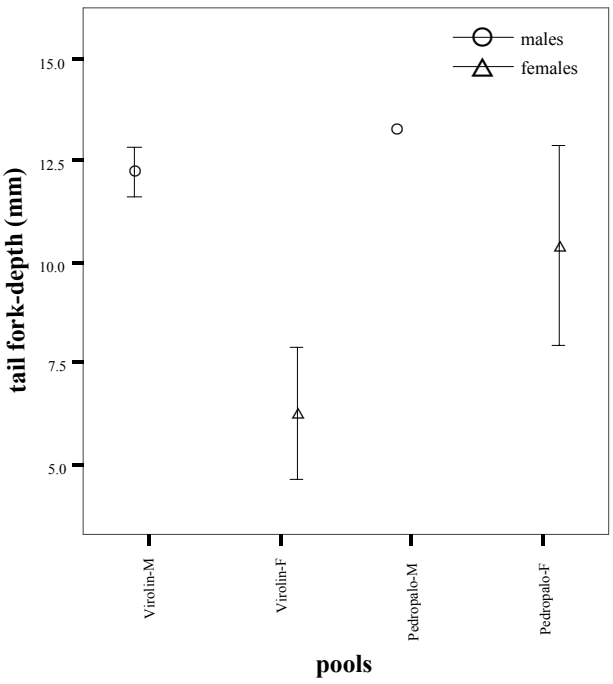


Figure 2.7.3. Geographic variation of the tail-length and the tail fork-depth in *C. prunellei*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical line the standard error of the mean. Pools are ordered from north to south.

1.8 *Coeligena lutetiae* (DeLattre & Bourcier, 1846)

1.8.1 Geographic distribution and taxonomy

Coeligena lutetiae ranges from the Central Andes of Colombia to the Andes of southern Ecuador, above 1200 m altitude; currently considered monotypic. The species was described by DeLattre and Bourcier (1846) from the Puracé Volcano, near Popayán, Colombia as *Trochilus Lutetiæ*, who noted in their description affinities of the taxon with *Trochilus Helianthea* Gould, 1848 and *Trochilus Bonapartei* Bourcier, 1842.

In later taxonomic revisions, the taxon was placed in the genus *Helianthea* Gould, 1848 by (e.g.) Bonaparte (1850); Reichenbach (1853) put it in the subgenus *Helianthea* within the genus *Helianthea* Gould, 1848; Gould (1861) included Ecuador in the distribution range, as did Elliot (1874, 1878) and Hartert (1900).

Goodfellow (1900) described a new species from Papallacta, eastern Ecuador: *Helianthea Hamiltoni*, mentioning the similarity of this species to *Helianthea Lutetiae* (DeLattre & Bourcier, 1846), which later would be included by Simon (1921) as a subspecies of *Calligena Lutetiæ*. Following his new classification system, Simon (1921) rejected Mulsant's (1875) proposal and excluded *Helianthea Dicrura* (sic), *H. osculans*, *H. Eos* and *H. violifera* from the genus *Calligenia* Mulsant, 1875, leaving the genus *Calligenia* Mulsant, 1875 with the only one species, *Calligena Lutetiæ*.

Peters (1945) listed the same taxon as one of the species of *Coeligena* Lesson, 1832, which is the current taxonomy of *Coeligena lutetiae* (Fjeldså & Krabbe 1990, Hilty & Brown 1986, Schuchmann 1999).

1.8.2 Diagnosis

The species is sexually dimorphic, the males having long black bills; head shining black with metallic Spectrum Green 62 frontal spot; nape like head; upperparts blackish Parrot Green 160; upper tail-coverts Olive-Green 47. The underparts are Spectrum Green 62; under tail-coverts Parrot Green 260 fringed Warm Buff 118; throat with a well-developed metallic Spectrum Violet 72 spot; the rectrices are Olive-Green 49. The upperwing-coverts Olive-Green 49; primary and secondary remiges Raw Umber 23; tertiaries with a conspicuous Cinnamon 39-Buff 124 patch. Females have glittering Parrot Green 160 underparts; head with poorly developed turquoise Spectrum Green 62 front patch. The chin and throat are Cinnamon

39, sometimes with a few violet feathers; underparts yellowish Spectrum Green 62. The remainder is similar to the male. Immatures similar to the females.

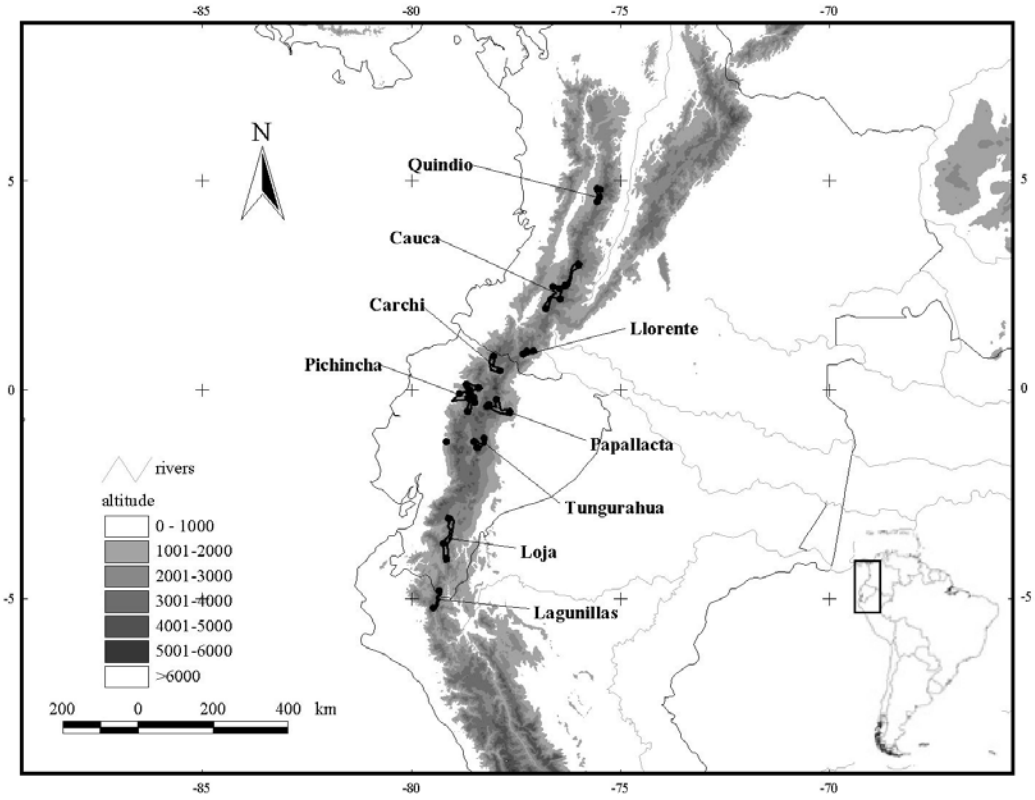


Figure 2.8.1. Geographic distribution of *C. lutetiae*. The polygons represent the geographic pools, the dots the localities.

1.8.3 Geographic variation analysis

A total of 149 skins of *Coeligena lutetiae* (89 males, 54 females and 6 immatures) was examined. The localities were grouped into nine pools (Fig. 2.8.1). Below is the list of these pools, ordered from north to south, and the descriptions of the corresponding areas.

1. Quindio: located west of Quindio, in the Central Andes of western Colombia, between 2400 and 3900 m a.s.l.

2. Cauca: located from Nevado del Huila National Park southwards to the Puracé National Park, in the Central Andes of southwestern Colombia, between 1700 and 3800 m.

3. Llorente: located south of Pasto, on the eastern slopes of the southern Colombian Andes, near the border of Colombia and Ecuador, between 3200 and 3400 m.

4. Carchi: located between Maldonado and Tulcan, on the western slopes of the northern Ecuadorian Andes, near the border with Colombia, between 3100 and 3300 m.

5. Pichincha: located in the vicinity of Quito and the Pichincha Volcano, on the western slopes of the northern Ecuadorian Andes, between 2700 and 4800 m.

6. Papallacta: located in the vicinity of Baeza and the Sumaco Volcano, on the eastern slopes of the northern Ecuadorian Andes, between 2500 and 3800 m.

7. Tungurahua: located on the Cordillera Llanganates, northeast of Tungurahua, on the eastern slopes of the Andes of central Ecuador, between 2500 and 4000 m.

8. Loja: located between Zamora and the headwaters of the River Jubones, on the eastern slopes of the southern Ecuadorian Andes, between 2800 and 3300 m.

9. Lagunillas: located in the border of Ecuador with Peru, on the eastern slopes of the Andes, between 2600 and 3000 m.

1.8.3.1 Morphometric variation

Specimens of *Coeligena lutetiae* showed significant sexual dimorphism in all the measured parameters, the males having shorter bills, longer wings and longer, more deeply forked tails than the females (Tab. 2.8.1). Significant morphometric variation was also found between pools and between sexes within the pools, the sexual morphometric differences tending to be more significant towards central Ecuador (Fig. 2.8.3-4). The shortest bills and the least significant sexual dimorphism ($p<0.05$) were found in the northernmost and southernmost pools of Quindio (pool 1, males: 36.8±0.61 mm; females: 39.1±1.19 mm) and Lagunillas (pool 9, males: 36.2±0.78 mm; female: 41.0 mm), whereas both sexes from the pools of Llorente (3), Carchi (4), Papayacta (5) and Pichincha (6) had the longest bills ($p<0.01$ bill-length males: 38.1-39.4 mm, females: 41.1-42.5 mm), with the most significant sexual dimorphism. The wing-length showed the same tendency, the specimens from Pichincha (5) and Papayacta (6) exhibiting the longest wings with the most significant sexual dimorphism (males: 76.8-77.3 mm; females: 72.5-73.4 mm). No other significant difference was found between the pools.

1.8.3.1 Plumage variation

The plumage coloration pattern in *Coeligena lutetiae* from Quindio, in central Colombia (pools 1 to 3) to the Lagunillas pool, on the eastern slopes of the Andes of northern Peru

(pools 6 to 9), showed very little geographical variation, the males with black heads; frontal spot large, metallic bluish Spectrum Green 62; nape and upperparts blackish Dark Green 262; lower back less black; upper tail-coverts Olive-Green 46. The chin and throat are bluish metallic Parrot Green 260; gular spot metallic violet Spectrum Blue 69; underparts like the throat; belly more yellowish; under tail-coverts Parrot Green 160 occasionally bordered Warm Buff 118; tail feathers are Olive-Green 46 with no tips. The wings-coverts are less blackish than the upperparts; primary and secondary remiges Raw Umber 223; tertiary remiges completely Cinnamon 39, tipped Raw Umber 223. The females had head and upperparts very yellowish Dark Green 262, with scaly pattern on the head; upper tail-coverts bronzy Parrot Green 260. The chin and throat are dark Clay Color 123B, bordered with tiny glittering Spectrum Green 62 discs; underparts yellowish

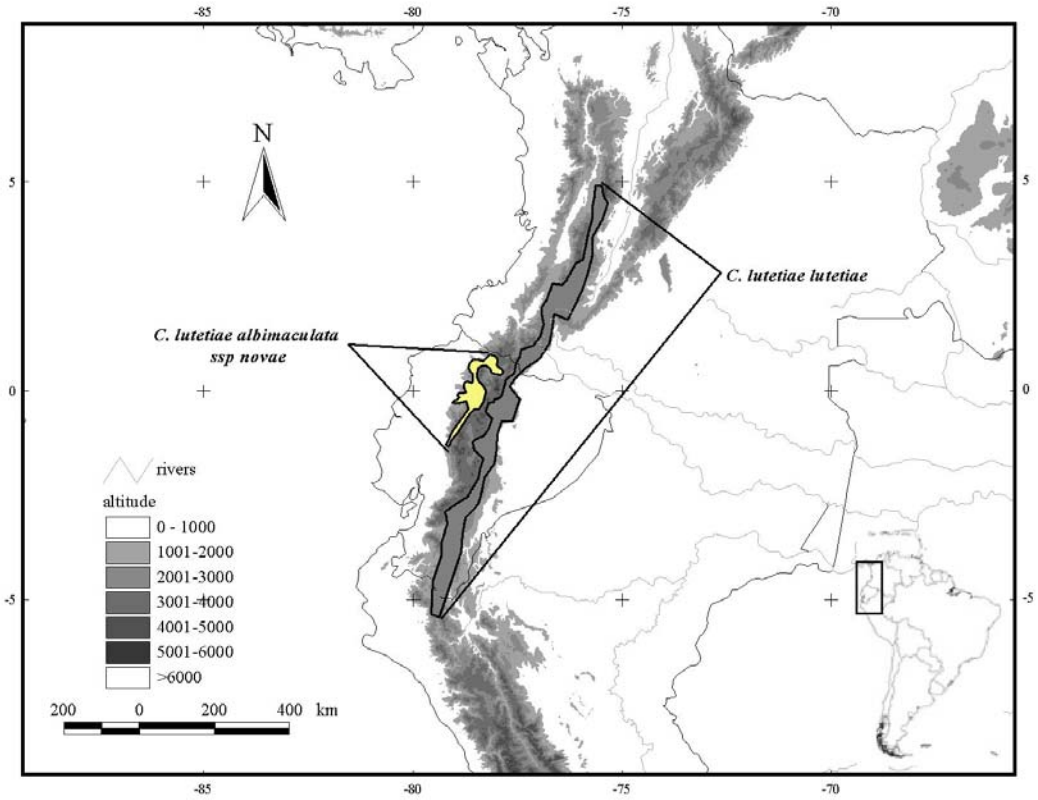


Figure 2.8.2. Geographic distribution of *C. lutetiae*. The subspecies ranges is represented by the polygons. See text for details.

Dark Green 262 with very few brownish white mixture; under tail-coverts yellowish Parrot Green 260 bordered Clay Color 123B; rectrices Greenish-Olive 49 slightly tipped white. The wings are like in males, with paler tertiary remiges.

The pools located on the western slopes of the Ecuadorian Andes (Carchi, pool 4 and Pichincha, pool 5) presented strikingly constrasting differences, allowing a clear separation from the pool on the eastern slopess. The males from these pools differ from those from the

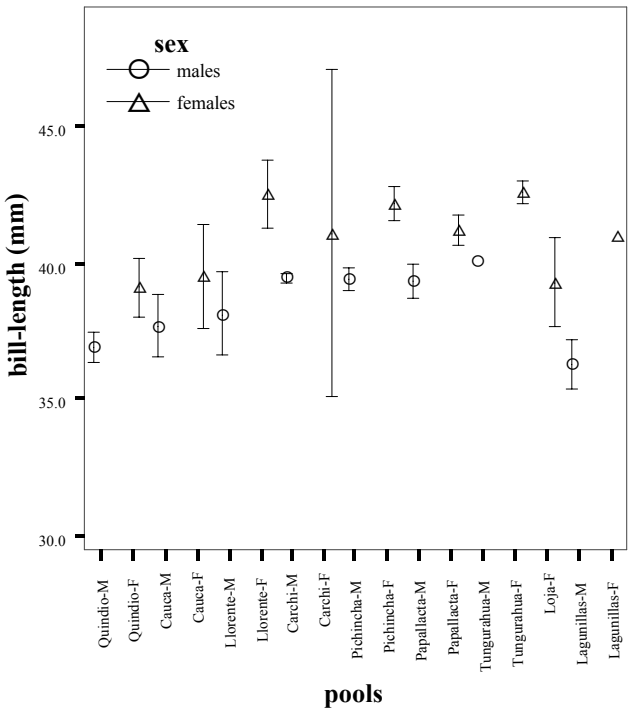
eastern Andean slopes in the greener hue on the upperparts, the dark brownish olive on the upper tail-coverts and the conspicuous white coloration of the tertiary remiges, with the base very pale Cinnamon 39 and tipped Raw Umber 223. The females also differ from those of the eastern Andean, having the upperparts less yellowish; upper tail-coverts with no bronzy hue; chin, throat and anterior chest pale Clay Color 123B very mixed with white, with only the sides being bordered with tiny glittering bluish Spectrum Green 62 discs; underparts very mottled with white on the chest and with Clay Color 123B on the belly; wings like males, with more Cinnamon 39.

1.8.4 Discussion

The degree of differentiation in the morphometry and plumage coloration and the isolation through the central Ecuadorian Andes from the eastern Andean groups indicate the presence of an unknown race of *Coeligena lutetiae*, which provisionally will be called *C. lutetiae albimacualta* ssp nov. (Sánchez Osés 2003,. submitted.).

Table 2.8.1. Descriptive statistics of the morphometric parameters in *C. lutetiae*. The pools are ordered geographically from north to south

Morphometric parameters	Pools	Quindio	Cauca	Llorente	Carchi	Pichincha	Papayacta	Tungurahua	Loja	Lagunillas
Bill-length (mm)	males									
	mean	36.8	37.7	38.1	39.4	39.4	39.3	40.1	-	36.2
	±S.D.	0.61	1.30	2.32	0.15	0.98	1.40	-	-	0.78
	Max.	37.6	39.6	40.8	39.6	42.1	41.8	-	-	37.1
	Min.	36.2	36.2	32.5	39.3	37.7	36.1	-	-	35.6
	N	5	5	9	3	24	21	1	-	3
	females									
	mean	39.1	39.6	42.5	41.1	42.1	41.2	42.6	39.3	41.0
	±S.D.	1.19	1.34	1.24	4.24	1.38	1.04	0.28	1.4	-
	Max.	40.4	40.5	43.8	44.1	44.3	42.7	42.8	40.3	-
	Min.	37.2	38.6	40.9	38.1	40.0	39.8	42.4	37.7	-
	N	5	2	4	2	21	13	2	3	1
Wing-length (mm)	males									
	mean	73.6	74.8	75.8	75.8	77.3	76.8	70.0	-	72.6
	±S.D.	1.10	2.84	2.18	0.51	2.00	1.71	-	-	2.77
	Max.	75.3	77.6	79.3	76.4	82.3	81.3	-	-	75.0
	Min.	72.0	70.6	70.6	75.4	63.9	74.3	-	-	69.6
	N	6	5	10	3	32	25	1	-	3
	females									
	mean	68.6	69.0	69.6	73.0	73.4	72.5	70.7	70.6	71.7
	±S.D.	2.80	1.13	2.54	2.12	2.50	2.21	-	0.78	-
	Max.	70.6	69.8	71.7	74.5	79.4	78.2	-	71.1	-
	Min.	63.8	68.2	65.9	71.5	68.6	70.7	-	69.7	-
	N	5	2	4	2	22	13	1	3	1
tail-length (mm)	males									
	mean	46.0	47.6	46.8	47.4	44.7	44.2	48.7	-	45.5
	±S.D.	1.30	1.30	1.62	1.00	5.60	4.46	-	-	1.04
	Max.	47.4	49.0	49.4	48.3	51.0	49.4	-	-	46.7
	Min.	44.5	46.2	44.4	46.3	34.0	34.2	-	-	44.9
	N	5	5	10	3	30	27	1	-	3
	females									
	mean	43.5	41.7	42.8	43.5	43.6	42.0	43.1	42.6	44.2
	±S.D.	1.92	1.31	2.21	0.14	2.36	1.76	-	1.04	-
	Max.	46.2	43.1	45.4	43.6	48.4	44.6	-	43.3	-
	Min.	41.7	40.5	40.1	43.4	39.1	38.7	-	41.4	-
	N	4	3	4	2	22	13	1	3	1
tail fork-depth (mm)	males									
	mean	11.2	12.2	9.6	10.1	6.6	6.8	6.8	-	11.2
	±S.D.	1.28	1.27	1.66	0.40	6.62	5.34	-	-	2.00
	Max.	12.7	13.7	11.7	10.5	14.2	11.7	-	-	13.3
	Min.	9.7	11.4	7.1	9.7	-5.7	-6.6	-	-	9.3
	N	5	3	7	3	27	25	1	-	3
	females									
	mean	10.0	6.6	7.6	7.0	6.6	6.2	7.3	5.9	8.6
	±S.D.	2.62	1.90	0.90	0.64	3.30	2.10	-	1.42	-
	Max.	11.9	7.9	8.5	7.5	13.5	9.7	-	6.8	-
	Min.	8.2	5.2	6.7	6.6	-4.2	2.5	-	4.3	-
	N	2	2	4	2	21	12	1	3	1



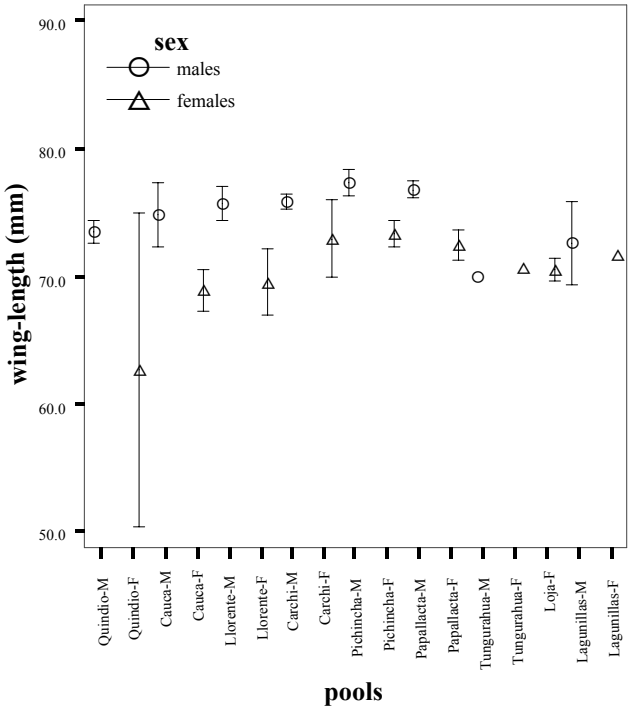
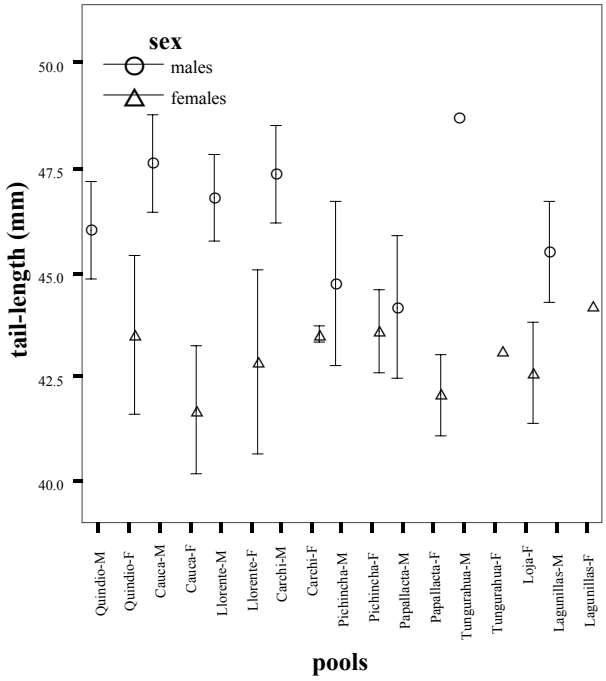


Figure 2.8.3. Geographic variation of the bill- and wing-length in *C. lutetiae*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical line the standard error of the mean. The pools are geographically ordered, from north to south.



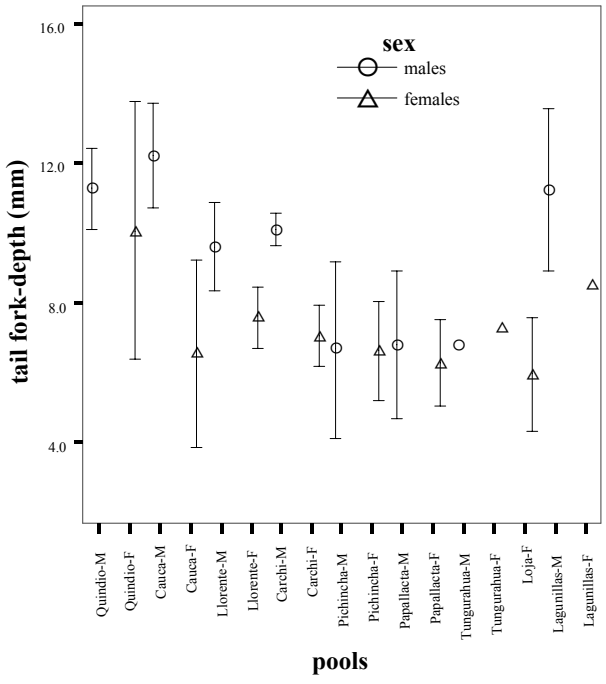


Figure 2.8.4. Geographic variation of the tail-length and tail fork-depth in *C. lutetiae*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical line the standard error of the mean. The pools are geographically ordered, from north to south.

1.9 *Coeligena wilsoni* (DeLattre & Bourcier, 1846)

1.9.1 Geographic distribution and taxonomy

Coeligena wilsoni is a low-Andean trochilid, currently considered monotypic, that occurs from the West Andes of northern Colombia to the western slopes of the Central Andes of southern Colombia and Ecuador (Hilty and Brown 1986, Ridgely and Greenfield 2001, Schuchmann 1999).

The taxonomy of this species has been problematic (as in *C. prunellei*), being marked by the uncertainty of which group (genus) it would be better to place it in. The species was first described by DeLattre and Bourcier (1846) as *Trochilus Wilsoni* with a specimen from Las Juntas, near Santa Buenaventura, Colombia. Bonaparte (1850) included the taxon in the genus *Bourcieria* Bonaparte, 1850 and Reichenbach (1853) in the subgenus *Lampropygia* Reichenbach, 1853, and it was later included in the genus *Lampropygia* Reichenbach, 1853 by Gould (1861), and placed again into *Bourcieria* by Elliot (1878).

Hartert (1900) included the species in the genus *Helianthea* Gould, 1848, and later Simon (1921) adopted the Gould's (1861) classification. Peters (1945) listed the taxon under the genus *Coeligena* Lesson 1832, and this is the present widely accepted classification (Fjeldså & Krabbe 1990, Schuchmann 1999).

1.9.2 Diagnosis

Coeligena wilsoni does not present evident sexual dimorphism in the plumage coloration, with both sexes having head, nape, and upperparts bronzy Olive-Green 46; lower back Olive-Green 46 with glittering turquoise Lime Green 159; upper tail-coverts dark Maroon 31. The chin and the throat are scaly metallic Mauve 75 on Greenish-Olive 49 with two conspicuous white spots on the sides of the breast; underparts Greenish-Olive 49 fringed Cinnamon 39; under tail-coverts yellowish Olive-Green 50 with Cinnamon 39 tips. The rectrices are yellowish Olive-Green 50; wing-coverts like back, with 'shoulder' bronze; remiges Raw Umber 223.

1.9.3 Geographic variation analysis

A total of 55 males and 41 females of *Coeligena wilsoni* was studied. The localities were grouped in five pools (Fig. 2.9.1). Pools and description of the corresponding areas are ordered from north to south:

1. Pisones: located north of Quindio, on the western bank of the River Cauca in the Western Andes of western Colombia, between 1600 and 2300 m a.s.l.

2. El Tambo: located south of Popayan, near the headwater of the River Cauca and the Puracé Volcano, between 500 and 2400 m.

3. Nariño: located in the Nariño region, on the western slopes of the Andes of south-western Colombia and northern Ecuador (Carchi), between 1000 and 2500 m.

4. Pichincha: located west of the Pichincha Volcano, on the western slopes of the north Ecuadorian Andes, between 1000 and 1800 m.

5. El Oro: located in the Province of El Oro, near the border with Peru, on the western slopes of the south Ecuadorian Andes, between 500 and 1700 m.

1.9.3.1 Morphometric variation

Males showed shorter bills, with wings and tails longer and more deeply forked than females (Tab. 2.9.1, Fig. 2.9.3- 4). No significant differences were found in bill-length among males, but the females from the pool Pisones to Nariño (1-3) have significantly longer bills (37.6-37.9 mm) than the females from Pichincha and El Oro (pools 4 and 5; bill-length 34.2-36.6 mm). Of the specimens from the pools Pisones to Nariño (1-3), the males have on average longer wings (70.6-73.0 mm) and both sexes exhibit longer and more deeply forked tails (male tail-length: 44.2-45.2 mm; tail fork-length: 6.4-7.4 mm; female tail-length: 39.8-40.2 mm; tail-fork: 3.2-4.1 mm) than specimens from Pichincha and El Oro (pools 4 and 5; male wing-length: 67.9-69.8 mm, tail-length: 40.6-42.0 mm, tail fork-depth: 5.4-3.6 mm; female: tail-length: 35.2-37.5, tail-fork-depth: 0.6-1.6 mm).

1.9.3.2 Plumage variation

The pools form two groups, according to similarities in plumage coloration patterns. The first group is formed by the pools in western and southern Colombia: Pisones and El Tambo (1 and 2), whose males show head and nape conspicuous reddish bronze, more

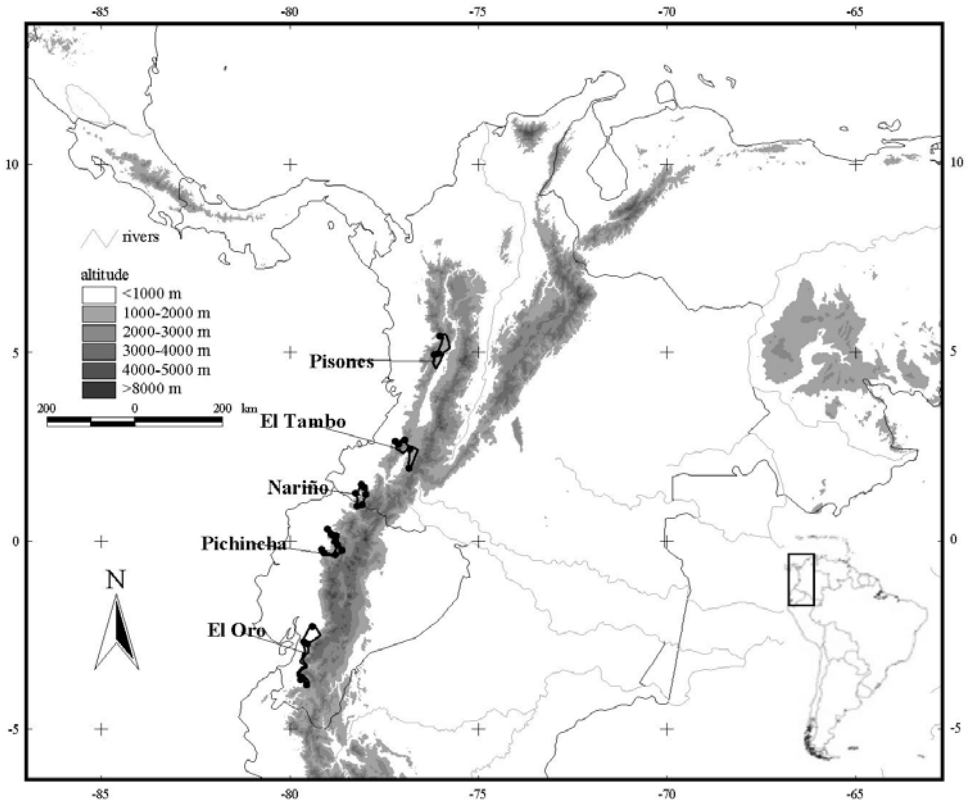


Figure 2.9.1. Geographic distribution of *C. wilsoni*. The polygons represent the geographic pools, the dots the localities.

greenish at the nape; upperparts Leaf Green 146 with bronze borders; lower back bronzy with increasing glittering Apple Green 61 borders; upper tail-coverts bronze Maroon 31; rectrices bronzy Olive-Green 47. The chin is Grayish Olive 43; throat metallic Bluish Violet 172B fringed white; sides with large white spots; underparts Grayish Olive 47 fringed reddish Cinnamon 39; under tail-coverts Grayish Olive 47 with borders reddish Cinnamon 39. The females are very similar to the males, showing less green on the head and more bronze on the nape; less green on the lower back; throat violet coloration more fringed white; tail feathers like males tipped brownish white.

The second group is formed by the pools Nariño, Pichincha and El Oro (3-5). The males are similar to the males of the first group, having a bronze head with frontal part bronzy Olive-Green 46; nape like head; upper back bronzy Olive Green 46; lower back Olive-Green 46 with increasing metallic Lime Green 159 mixed with metallic bluish Turquoise Green 64; upper tail-coverts bronzy Olive-Green 50. The underparts are similar to first pool group; rectrices with tipping reduced. The females are similar to those of the first group, differing in the upper tail-coverts bronzy Olive-Green 50 coloration.

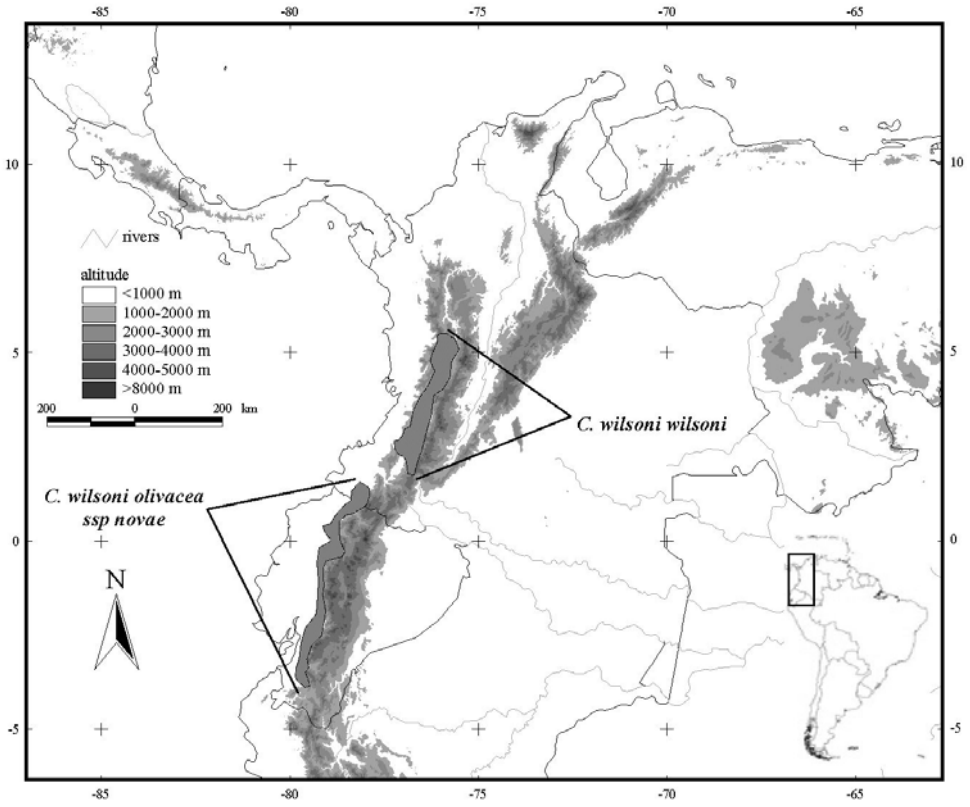


Figure 2.9.2. Geographic distribution of *C. wilsoni*. The subspecies ranges are represented by filled polygons. See text for details.

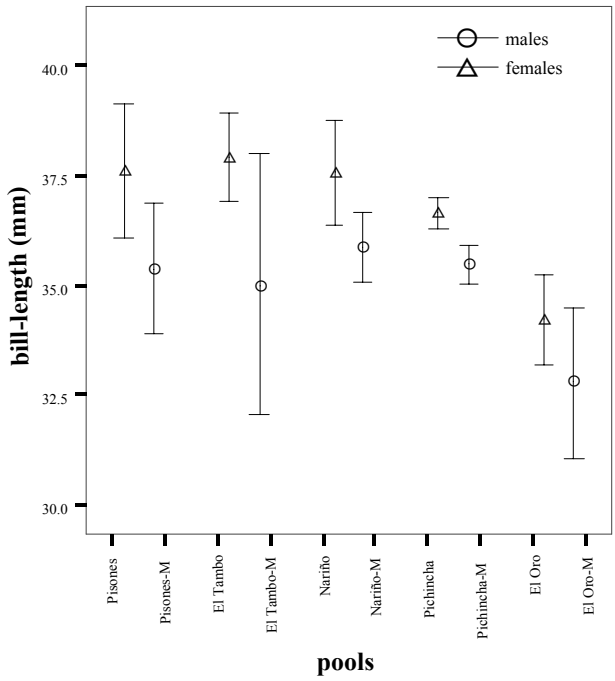
1.9.4 Discussion

The coloration pattern observed in the specimens of the Colombian pools corresponds to the first description made for the species (DeLattre & Bourcier 1846), since no description or taxonomical denomination for the populations from Ecuador existed at that time.

The differences between the populations and the geographic isolation are a clear indication of the presence of two geographic races. This new subspecies is recognisable mainly by the much less overall bronzy coloration and the definitively olive upper tail-coverts coloration. The taxon is provisionally named *C. wilsoni olivacea* ssp nov. (Sánchez Osés 2003, submitted.).

Table 2.9.1. Descriptive statistics of the morphometric parameters in *C. wilsoni*. The pools are ordered geographically from north to south.

Morphometric parameters	Pools	Pisones	El Tambo	Nariño	Pichincha	El Oro
bill-length (mm)	males					
	mean	35.4	35.0	35.8	35.4	32.9
	±S.D.	1.30	2.58	1.45	0.90	2.9
	Max.	36.7	37.8	39.7	37.5	36.1
	Min.	34.1	32.7	33.7	33.9	25.1
	N	3	3	14	17	11
	females					
	mean	37.6	37.9	37.6	36.6	34.2
	±S.D.	1.30	0.70	1.68	0.76	1.38
	Max.	39.1	38.4	39.6	37.7	36.6
	Min.	36.7	37.4	34.8	34.6	32.9
	N	3	2	8	19	7
wing-length (mm)	males					
	mean	70.6	71.2	73.0	69.8	67.9
	±S.D.	3.04	1.34	2.16	2.36	2.06
	Max.	74.7	72.2	76.3	74.0	71.5
	Min.	67.6	70.3	68.1	65.7	64.9
	N	4	2	13	18	11
	females					
	mean	65.8	66.3	68.4	66.8	62.9
	±S.D.	1.10	0.42	3.22	2.27	1.34
	Max.	66.4	66.6	74.2	74.2	64.8
	Min.	64.5	66.0	63.3	64.2	61.5
	N	3	2	10	18	7
tail-length (mm)	males					
	mean	44.2	45.2	44.8	40.6	42.0
	±S.D.	0.86	1.90	1.38	2.27	1.88
	Max.	44.9	46.5	46.8	44.1	44.8
	Min.	42.9	43.8	43.1	36.3	39.4
	N	4	2	12	18	11
	females					
	mean	40.2	39.8	40.0	37.5	35.2
	±S.D.	2.62	1.48	2.46	1.76	1.31
	Max.	42.1	40.9	43.3	43.2	37.2
	Min.	38.4	38.8	36.3	34.7	33.6
	N	2	2	10	19	7
tail fork-depth (mm)	males					
	mean	6.4	6.4	7.35	3.6	5.4
	±S.D.	0.86	0.42	1.95	1.98	1.89
	Max.	6.9	6.7	11.5	6.7	7.9
	Min.	5.1	6.1	5.1	-0.1	2.3
	N	4	2	11	18	11
	females					
	mean	3.8	4.1	3.26	1.64	0.6
	±S.D.	0.21	2.4	2.19	1.64	1.34
	Max.	4.0	5.8	5.8	6.1	3.7
	Min.	3.7	2.4	-0.5	-0.5	-1.2
	N	2	2	9	19	7



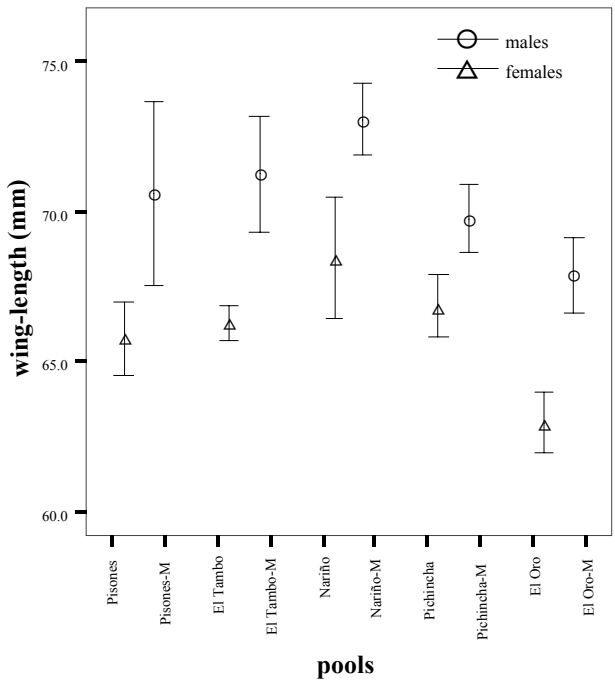
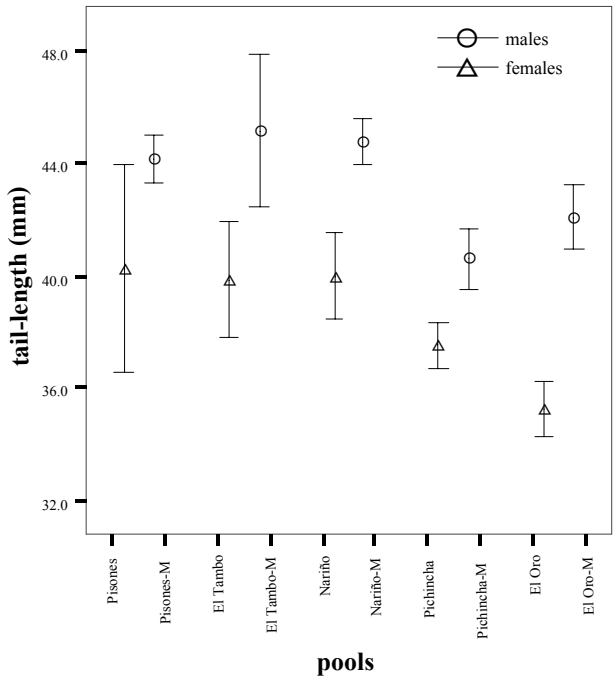


Figure 2.9.3. Geographic variation of the bill- and wing-length in *C.wilsoni*. The circles and the triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. The pools are ordered geographically from north to south.



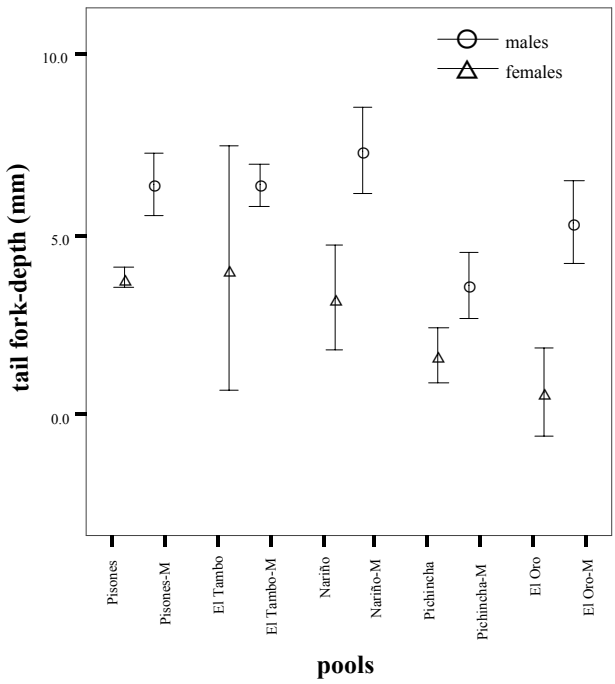


Figure 2.9.4. Geographic variation of the tail-length and tail fork-depth in *C.wilsoni*. The circles and the triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. The pools are ordered geographically from north to south.

1.10 *Coeligena violifer* (Gould, 1846)

1.10.1 Geographic distribution and taxonomy

Coeligena violifer is a high-Andean trochilid that occurs only on the eastern slopes of the north Peruvian to the north Bolivian Andes, above 2800 m. Three subspecies are currently recognised: *C. v. dichroura* presumably from the Loja region, southern Ecuador, to the Andes of northern and central Peru, with one relict population in the Department of Lima, Peru, on the western slopes of the central Peruvian Andes (Fjeldså & Krabbe 1990, Koepcke 1970); *C. v. albicaudata* in the Apurimac region, southern Peru; *C. v. osculans* in the eastern Andes of southeastern Peru (southeast of Urubamba) and *C. v. violifer* in the Andes of northwestern Bolivia (Schuchmann 1999). The species was first described by Gould in 1846 and named *Trochilus '*(_____?)' *violifer*, being subsequently included in the genus *Helianthea* Gould, 1848 by Bonaparte (1850).

This classification was maintained except for some slight changes in the spelling ('*violifera*': Elliot 1878, Gould 1861, Reichenbach 1853, Simon 1921; '*violifer*': Hartert 1900). Gould (1871) described *Helianthea osculans*, from 'Ecachupata' (Iccachubata) and Huasampilla, Peru, from a specimen collected by Henry Whitely. Three years later, Taczanowski (1874) presented the species *Helianthea dichroura*, based on a specimen collected by Jelski in Maraynioc, Peru. This new species differed from *H. osculans* in the more conspicuous olive tipping on the tail, and for this reason, Elliot (1874) doubted the validity of its species status, it being necessary to prove that it was not rather a geographic variation of *H. osculans*. Simon (1921) included the three taxa described into *Pseudodiphlogena*, one of his subgroups of *Helianthea* Gould, 1848.

Peters (1945) listed the same taxa as subspecies of *Coeligena violifer* (Gould, 1846). This classification is maintained by Zimmer (1951a) and Fjeldså & Krabbe (1990), who considered *C. v. osculans* (Gould, 1871) as the product of an intergradation between two subspecies, *C. v. dichroura* (Taczanowski, 1874) in the north and *C. v. violifer* (Gould, 1846) in the south. Schuchmann and Züchner (1997) resolved this suspicion with the discovery of the subspecies *C. v. albicaudata*, from the Cordillera Vilcabamba, Cuzco, Peru, located in the possible zone of intergradation proposed by Fjeldså and Krabbe (1990), raising to four the number of recognised subspecies.

1.10.2 Diagnosis

The species is sexually dimorphic, with the males having a long black bill; the head is greenish black; upperparts shining bronzy Parrot Green 260; under tail-coverts Tawny 38. The throat and breast are Parrot Green 260 with a well-developed metallic SpectrumViolet 72 spot and a thin greyish white band across the upper breast; lower breast Parrot Green 260 fringed Tawny 38; belly and under tail-coverts Tawny 38; tail forked, Tawny 38 with bronzy Olive-Green 46 tips. Female similar to male with longer bill; the head is dark Parrot Green 260; throat and upper breast pale Cinnamon 39 with small Parrot Green 260 discs; underparts and under tail-coverts Cinnamon 39; tail less deeply forked. Immatures resemble adult females.

1.10.3 Geographic variation analysis

A total of 123 specimens of *Coeligena violifer* (76 males, 26 females and 21 immatures) was analysed. The localities were grouped in 11 geographic pools (Fig. 2.10.1). The pools and the descriptions of the corresponding areas are listed, ordered from north to south:

1. Amazonas: located southeast of the confluence of the Rivers Chinchipe and Marañon (Pongo de Rentana), on the eastern slopes of the Andes, northern Peru, between 2100 and 3200 m a.s.l.

2. San Martin: located on the eastern bank of the River Marañon, Departamento San Martin, south of Amazonas pool, northern Peru, between 2700 and 3400 m.

3. Huanuco: located near Huanuco, in the mountain range between the Rivers Huallaga and Marañon, central Peru, between 2700 and 3400 m.

4. Junin: located west of Junin Nature Reserve, between the Rivers Paucartambo and Oxabamba, in central Peru, between 3000 and 4400 m.

5. Vilcabamba: located on the Cordillera Vilcabamba, on the eastern bank of the River Apurimac, southern Peru, between 2300 and 3500 m.

6. Ayacucho: located beside the Vilcabamba pool, on the western bank of the River Apurimac, in southern Peru, between 3300 and 3600 m.

7. Amplay: located near Abancay, near the headwaters of the River Apurimac, in central Peru, between 3400 and 3500 m.

8. Cuzco: located near Macchu Picchu, Cuzco, south-western Peru, between 2600 and 3500 m.

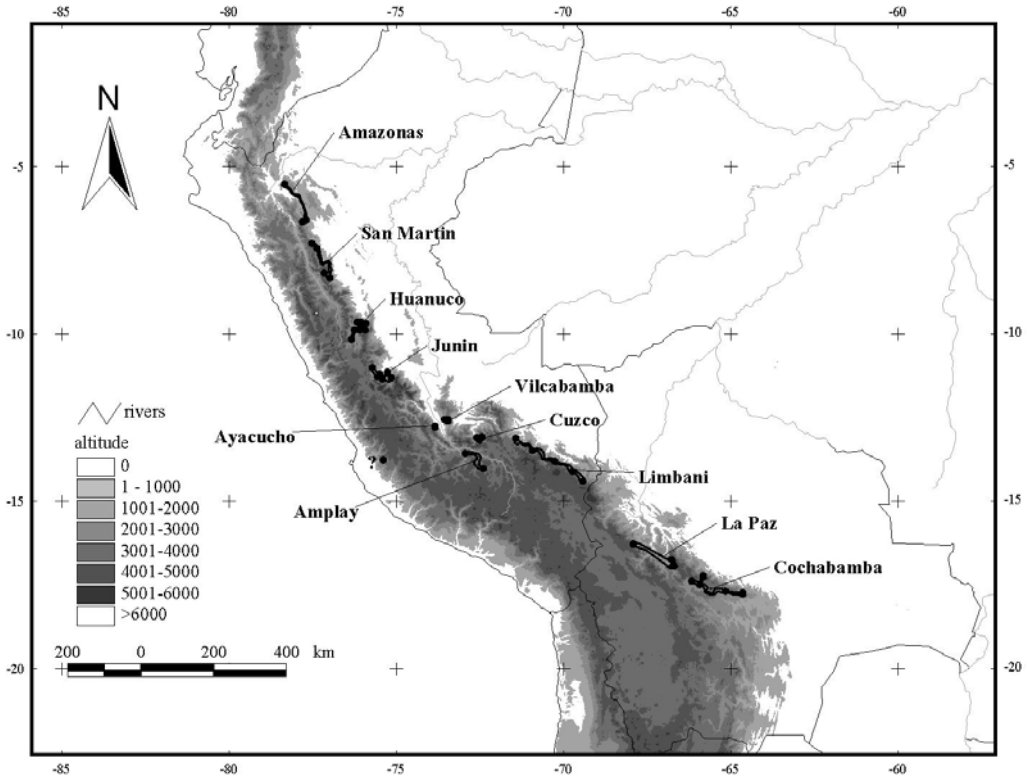


Figure 2.10.1. Geographic distribution of *C. violifer*. The polygons represent the geographic pools, the dots the localities.

9. Limbani: located east of Amplay pool, along the southernmost Peruvian Andes (Cordillera Carabaya) to the border with Bolivia, between 2500 and 3500 m.

10. La Paz: located near La Paz, central Bolivia, between 2200 and 3600 m.

11. Cochabamba: located on the Yungas de Cochabamba, east of Cochabamba, central Bolivia, between 1700 and 3300 m.

1.10.3.1 Morphometric variation

Males of *Coeligena violifer* have shorter bills, longer wings and tails, and more deeply forked tails than females (Tab. 2.10.1, Fig. 2.10.3-4). A significant increment in male bill-, wing- and tail-lengths in a north-south direction was observed ($p<0.01$), ranging from the Amazonas pool (1), in northeastern Peru, to Junin (pool 4), central Peru (bill-length males: 42.4-40.0

mm; females: 44.6-40.7 mm; tail-length males: 50.6-53.4 mm; females: 44.0-47.4 mm; wing-length males: 78.9-83.2 mm; females 73.7-75.0 mm).

1.10.3.2 Plumage variation

The pools from northwestern to central Peru (1 to 4) were grouped according to the strong similarities in the coloration. The head in males is blackish dark Parrot Green 260 fringed golden, with a metallic yellowish Cyan 164 frontal spot; nape like head; upper back golden-bronzy Parrot Green 260, turning into orange Olive-Green 46 on the lower back; upper tail-coverts golden Olive-Green 47. Chin and throat are glittering dark golden Parrot Green 260 with a well-developed gular patch bluish True Violet 172 (as wide as the throat); chest bluish dark Parrot Green 260 with a white inconspicuous transversal band; underparts golden Olive-Green 47 mottled Cinnamon 39; hind belly Cinnamon 39; under tail-coverts Cinnamon 39 centred Olive-Green 47. The inner tail feathers are Olive-Green 47, outer tail feathers two-thirds Cinnamon 39, terminating Olive-Green 47. The females are similar to the males, with head golden dark Parrot Green 260 without the metallic blue spot; upperparts golden Parrot Green 260, more golden on the lower back; upper tail-coverts golden Olive-Green 47. Chin and throat are scaly glittering Parrot Green 160 on tawny white background; upper chest like the throat; underparts golden Parrot Green 160 mottled Cinnamon 39; belly Cinnamon 39; under tail-coverts Cinnamon 39. The rectrices are similar to those of males.

The pools Vilcabamba (5) and Ayacucho (6) shared the same plumage characteristics, thus being lumped into one group. The males have dark Parrot Green 260 head, more blackish near the bill; frontal spot metallic Cyan 164; nape golden Parrot Green 260; upperparts bronzy Olive-Green 47; upper tail-coverts less bronze. Chin and throat are dark Parrot Green 260 with gular patch very bluish True Violet 172, narrower than the throat; chest bluish Parrot Green 260; belly yellowish Olive-Green 47 fringed Cinnamon 39; under tail-coverts brownish-greyish white with pale Brownish Olive 29 centres. The innermost rectrix is Olive-Green 47; the other outer rectrices dark Olive-Green 47. The females are similar to the males, lacking the frontal metallic spot. Chin and throat are scaly with small bluish Parrot Green 160 discs on tawny white background; upperparts bluish Parrot Green 160 mottled tawny white; posterior belly beige Chamois 123D mottled black; under tail-coverts Chamois 123D with pale Brownish Olive 29 centres.

The third pool group is formed by the pools Amplay, Cuzco and Limbani (7 to 9), characterised by the males having the head golden dark Parrot Green 260 with a metallic greenish Ultramarine 270 frontal spot; upperparts like the head; upper tail-coverts Parrot

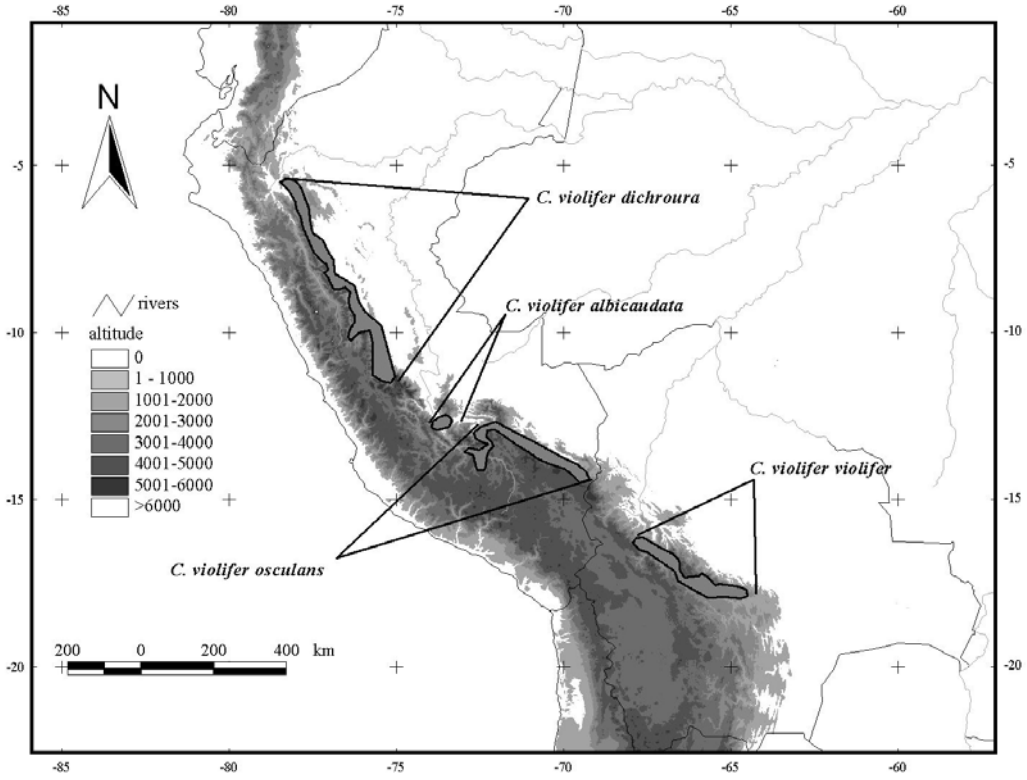


Figure 2.10.2. Geographic distribution of *C. violifer*. The subspecies ranges are represented by filled polygons.

Green 260 tipped Raw Umber 123. Chin and throat are Parrot Green 260 with metallic BluishViolet 172B gular patch, narrower than the throat; upperparts Parrot Green 160; belly Lime Green 59 fringed Cinnamon 39 and black; under tail-coverts Warm Buff 118. The first rectrix is two-thirds Warm Buff 118 with terminal third Olive-Green 49; other outer rectrices with only the tips olive. Females are similar to the males, having dark Parrot Green 160 heads; nape and upper back bronzy Parrot Green 260; lower back bronzy Parrot Green 260 fringed Cinnamon 39; upper tail-coverts Parrot Green 260. Chin and throat are scaly glittering Parrot Green 160 on pale Cinnamon 39 background; upperparts Parrot Green 160 with feathers bordered Cinnamon 39, anterior belly bronzy Parrot Green 160 fringed Cinnamon 39; posterior belly and under tail-coverts Cinnamon 39. The tail is similar to those in males.

Specimens below 3000 m altitude from the northern part of the pool (9) differ from the general pattern within the pool group, in having heads more blackish; nape bronzy Olive-Green 47 and back very reddish-greenish bronze; upper tail-coverts Olive-Green 49 tipped bronze. The underparts are more bronze; the gular patch is violet Cobalt 68. Females are similar to males in the overall bronze coloration, including the rectrices.

Tab. 2.10.1. Descriptive statistics of the morphometric parameters in *C. violifer*. The pools are ordered geographically from north to south.

Morphometric parameters	Pools	Pisones	El Tambo	Nariño	Pichincha	El Oro
bill-length (mm)	males					
	mean	35.4	35.0	35.8	35.4	32.9
	±S.D.	1.30	2.58	1.45	0.90	2.9
	Max.	36.7	37.8	39.7	37.5	36.1
	Min.	34.1	32.7	33.7	33.9	25.1
	N	3	3	14	17	11
	females					
	mean	37.6	37.9	37.6	36.6	34.2
	±S.D.	1.30	0.70	1.68	0.76	1.38
	Max.	39.1	38.4	39.6	37.7	36.6
	Min.	36.7	37.4	34.8	34.6	32.9
	N	3	2	8	19	7
wing-length (mm)	males					
	mean	70.6	71.2	73.0	69.8	67.9
	±S.D.	3.04	1.34	2.16	2.36	2.06
	Max.	74.7	72.2	76.3	74.0	71.5
	Min.	67.6	70.3	68.1	65.7	64.9
	N	4	2	13	18	11
	females					
	mean	65.8	66.3	68.4	66.8	62.9
	±S.D.	1.10	0.42	3.22	2.27	1.34
	Max.	66.4	66.6	74.2	74.2	64.8
	Min.	64.5	66.0	63.3	64.2	61.5
	N	3	2	10	18	7
tail-length (mm)	males					
	mean	44.2	45.2	44.8	40.6	42.0
	±S.D.	0.86	1.90	1.38	2.27	1.88
	Max.	44.9	46.5	46.8	44.1	44.8
	Min.	42.9	43.8	43.1	36.3	39.4
	N	4	2	12	18	11
	females					
	mean	40.2	39.8	40.0	37.5	35.2
	±S.D.	2.62	1.48	2.46	1.76	1.31
	Max.	42.1	40.9	43.3	43.2	37.2
	Min.	38.4	38.8	36.3	34.7	33.6
	N	2	2	10	19	7
Tail fork-depth (mm)	males					
	mean	6.4	6.4	7.35	3.6	5.4
	±S.D.	0.86	0.42	1.95	1.98	1.89
	Max.	6.9	6.7	11.5	6.7	7.9
	Min.	5.1	6.1	5.1	-0.1	2.3
	N	4	2	11	18	11
	females					
	mean	3.8	4.1	3.26	1.64	0.6
	±S.D.	0.21	2.4	2.19	1.64	1.34
	Max.	4.0	5.8	5.8	6.1	3.7
	Min.	3.7	2.4	-0.5	-0.5	-1.2
	N	2	2	9	19	7

The fourth group includes the Bolivian pools La Paz and Cochabamba (10 and 11), with male blackish dark Parrot Green 260 on head; the metallic-coloured frontal spot is absent; nape and upper back glittering golden Parrot Green 260; lower back golden Olive-Green 49; upper tail-coverts Raw Sienna 136. The chin and throat are dull dark Parrot Green 260; gular patch large True Violet 172, as wide as the throat; anterior chest bluish Spectrum Green 62, hind chest crossed by a conspicuous white band; underparts golden Parrot Green 160 mottled Raw

Sienna 136; belly Raw Sienna 136 mottled with black; under tail-coverts Raw Sienna 136. All rectrices are Raw Sienna 136 tipped Olive-Green 49. The females are similar to the males, with small discs Parrot Green 160 on the chin and throat, forming lines on Cinnamon background.

1.10.4 Discussion

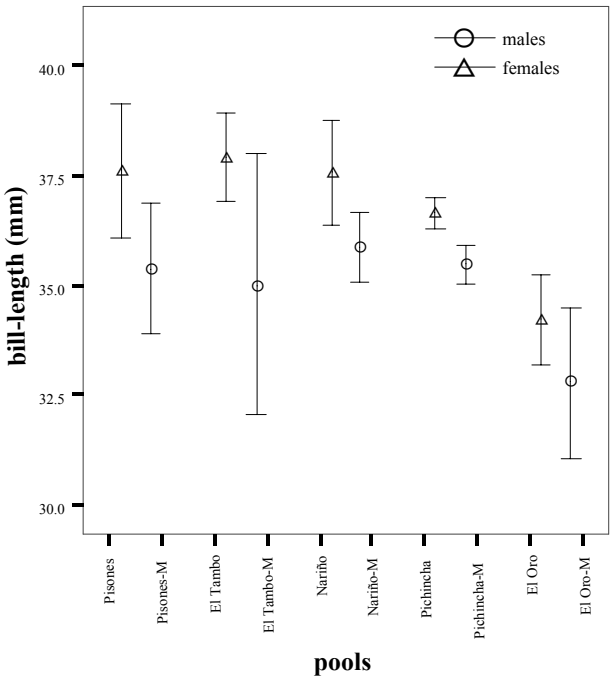
The northernmost group (pools 1 to 4) is distinct in its morphometric characteristics as well as in its plumage coloration, its diagnostic characters being the larger size, the well-developed violet gular patch, the faint trace of a white pectoral band and the olive coloration of the first rectrix. This group corresponds taxonomically to the race *Coeligena violifer dichroura* (Taczanowski, 1874). The range of this subspecies is usually reported to reach the southern Ecuadorian Andes in Loja, this being supported by a record from Loja, Ecuador, deposited in the Museum of Comparative Zoology, Harvard. This is perhaps an error, since this record is far out of the normal distribution range of the species (Fig. 2.10.2).

The small group formed by the pools Vilcabamba and Ayacucho (5 and 6) represents the subspecies *Coeligena violifer albicaudata* (Schuchmann & Züchner, 1997), restricted to mountains on both sides of the River Apurímac (Fig. 2.10.2). The taxon can be immediately distinguished by the white coloration of the rectrices and under tail-coverts, and the less-developed violet gular patch on the bluish green chest. This group represents the separation of the two morphologically similar neighbourimg pool groups, and is evidence supporting the validity of the subspecies that corresponds with the next southern pool group (see Schuchmann & Züchner 1997, and below).

Specimens of the group formed by the pools Amplay, Cuzco and Limbani (7 to 9) can be classified as *C. v. osculans* (Gould 1871), showing the least homogeneous coloration pattern of the ranges, sharing with specimens from the northernmost and southernmost groups (pools 1-6 and 10-11) several coloration aspects (e.g., one frontal spot like northern specimens, under tail-coverts like southern specimens) and showing apparently intermediate character states (e.g., upper tail-coverts and first rectrix coloration). Nevertheless, there are distinguishable constant character patterns defining this group: the diagnostic metallic blue colour of the frontal spot on the head; the less-developed bluish violet gular patch and the two-colour pattern on the first rectrix. Some lower altitude populations show a conspicuous overall reddish-bronzy hue, which it is not seen in any other pool (Fig. 2.10.2).

I agree with Zimmer (1951a) in considering this group a distinct race of the species, though the apparent intermediate condition of several coloration aspects. Geographical barriers effectively acted avoiding contact between the population, not existing zones of contact or intergradation.

The fourth and southernmost group (pools 10 and 11) corresponds with the range of the nominate subspecies, *C. v. violifer* (Fig. 2.10.2), is a good distinguishable unit characterised by the overall duller coloration, the total absence of the metallic frontal spot on the head, the well-developed violet gular patch, the pectoral transversal white band, and the first rectrix only tipped olive.



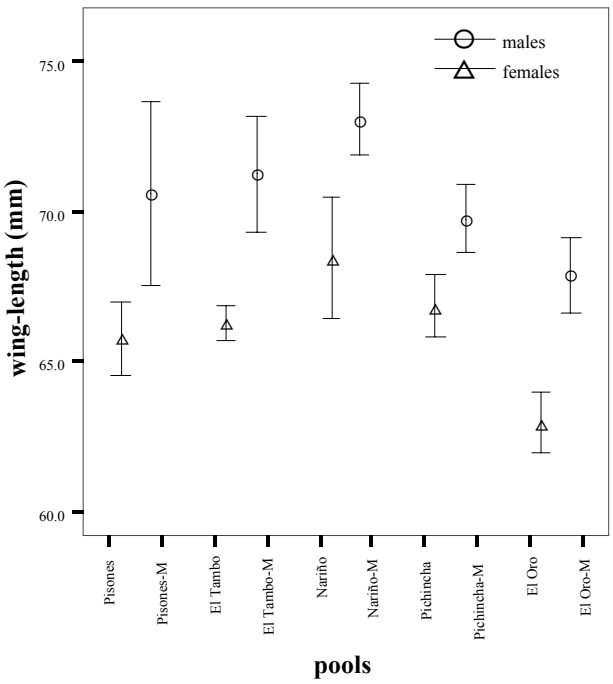
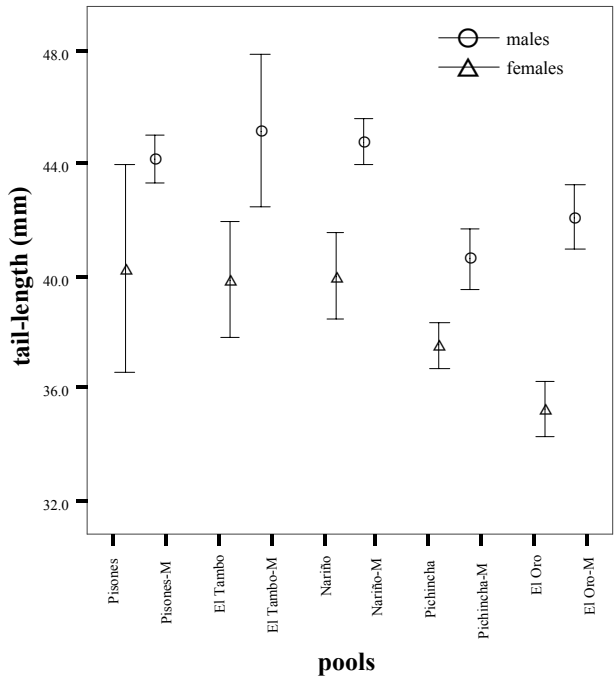


Figure 2.10.3. Geographic variation of the bill- and wing-length in *C. violifer*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. The pools are geographically ordered from north to south.



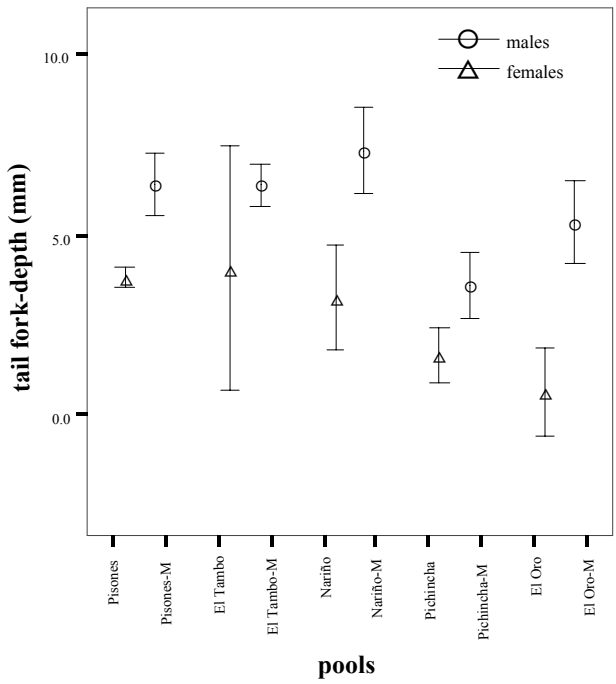


Figure 2.10.4. Geographic variation of the tail- and the tail fork-depth in *C. violifer*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. The pools are geographically ordered from north to south.

1.11 *Coeligena iris* (Gould, 1853)

1.11.1 Geographic distribution and taxonomy

Coeligena iris distribution consists of several isolated patchy populations, confined to the southern Ecuadorian and northern Peruvian Andes. Each of these disjunct populations represents one of the six currently recognised subspecies (Schuchmann 1999).

The subspecies *C. i. hesperus* is restricted to the Cuenca region, in southwestern Ecuador; *C. i. iris*, occurs from Loja, in southern Ecuador, to Piura, in northern Peru; *C. i. aurora* in the Cutervo region, in northwestern Peru; *C. i. fulgidiceps* is located on the eastern bank of the River Marañon, in the Chachapoyas region, northwestern Peru, and *C. i. flagrans* in the Cajamarca region, on the western bank of the River Marañon, northwestern Peru. The range of *C. i. eva* is not exactly known, being reported from the Cajamarca region, on the western bank of the River Marañon, northwestern Peru, with unclear separation from *C. i. flagrans*.

Coeligena iris taxonomy dates back to Gould's (1853) first descriptions of *Helianthea Iris*, and *Helianthea Aurora*, both from the 'eastern slopes of the Andes' (the syntypes of both species are deposited in Tring Museum and catalogued as collected in Bolivia by Warszewics (Warren 1966). In the same year, Reichenbach (1853) had listed these two species under the *Helianthea* subgenus *Hypochrysia*, and described a new species, *Coeligena Warszewizii*, from northern Peru. Comparison of the Gould (1853) and Reichenbach (1853) descriptions reveals that they are obviously of the same taxon. Nevertheless, Reichenbach (*op. cit.*) placed *C. Warszewizii* in the subgroup *Leadbeatera* Bonaparte, 1850, based on bill morphology and behavioural characteristics, and alleged phylogenetic relationships to the congeneric species *Leadbeatera Jacula* (Gould, 1850) (syn. *Heliodoxa jacula jacula*), from Colombia, and *Leadbeatera Jamersonii* (Bourcier, 1851) (syn. *Heliodoxa jacula jamesonii*), from Ecuador. Gould (1861) was aware of the priority problem with the names '*Aurora*' Gould, 1853 and '*Warszewizii*' Reichenbach, 1853, but maintained his as valid.

Additionally, the genus *Diphlogæna* was erected, into which was lumped the former *Helianthea Iris* and *Helianthea Aurora*, with the Andes of Bolivia given as the locality for *Diphlogæna Iris*, and Peru and Bolivia for *D. Aurora*. Gould (1865) described *Diphlogæna Hesperus* from Cuenca, Ecuador and later Berlepsch in 1887 described *D. i. bucleyi* from a male specimen (probably collected in Ecuador by Clarence Buckley).

For many authors, these taxa were distinct enough to keep them in a separate genus: *Diplogæna* Gould, 1861 (Elliot 1878 , Hartert 1900, Simon 1921), but the genus taxonomy was still not completely clarified. Further modifications were made, e.g., Elliot (1878) merged *D. Aurora* (Gould, 1853) into *D. Iris* (Gould, 1853), without mentioning *D. i. buckleyi* Berlepsch, 1887. Salvin in 1895 described a new species from eastern Peru, *Diphlogæna Eva*, from specimens collected by O. T. Baron.

Hartert (1900) listed four species and two subspecies for *Diphlogæna* Gould, 1861: *D. iris* (typica) (Gould, 1853); *D. i. buckleyi* Berlepsch, 1887; *D. hesperus* Gould, 1865; *D. aurora* (Gould, 1853) and *D. eva* Salvin 1895. Simon (1921) considered *D. i. buckleyi* Berlepsch, 1887 as a synonym of the nominate subspecies and described two more Peruvian subspecies of *D. iris*: *D. i. fulgidiceps* from Cochabamba, and *D. i. Hypocrita* from Amazonas (Chachapoyas).

Peters (1945) listed all the taxa mentioned above as subspecies of *Coeligena iris* (Gould, 1853) and considered *C. i. fulgidiceps* (Simon, 1921) and *C. i. hypocrita* (Simon, 1921) indistinguishable from the nominate race. Zimmer (1951a) described *C. i. flagrans*, from Chugur, Departament of Cajamarca, Peru and concluded that *Diphlogæna iris buckleyi* Berlepsch, 1887 and *D. i. hypocrita* Simon, 1921 are only extreme variant of the race *Coeligena iris fulgidiceps* (Simon 1921).

In his study, Zimmer (*op. cit.*) reviewed the problem of the name priority of '*aurora*' Gould, 1853 and '*warszewisii*' Reichenbach, 1853, deciding to continue with the use of '*aurora*' due to the lack of satisfactory evidence that could help to solve the dilemma.

No taxonomic change for *Coeligena iris* has been proposed until now, six subspecies for this study being recognised (Fjeldså & Krabbe 1990, Schuchmann 1999). Despite the apparent taxonomic stability of the group, there is enough morphological and geographic evidence for raising the taxon *Coeligena iris aurora* (Gould, 1853) to species level. This and other taxonomic conclusions will be discussed below.

1.11.2 Diagnosis

Coeligena iris is a dimorphic species, with males having a black bills; head completely dominated by the crown, with coloration dependent on light incidence angle, varying from fiery glittering metallic yellowish Spectrum Green 62 on the forecrown to fiery glittering metallic Flame Scarlet 15 hindcrown; hind border of the crown glittering metallic Cyanine

Blue 74; nape blackish and upperparts Chestnut 32. The chin and throat are glittering Shamrock Green 162B with a small True Violet 172 gular spot; underparts and under tail-coverts Chestnut 32; tail forked, Chestnut 32. Females similar to males; bills longer and overall coloration less metallic; the tail is less deeply forked. Immatures are similar to adult females.

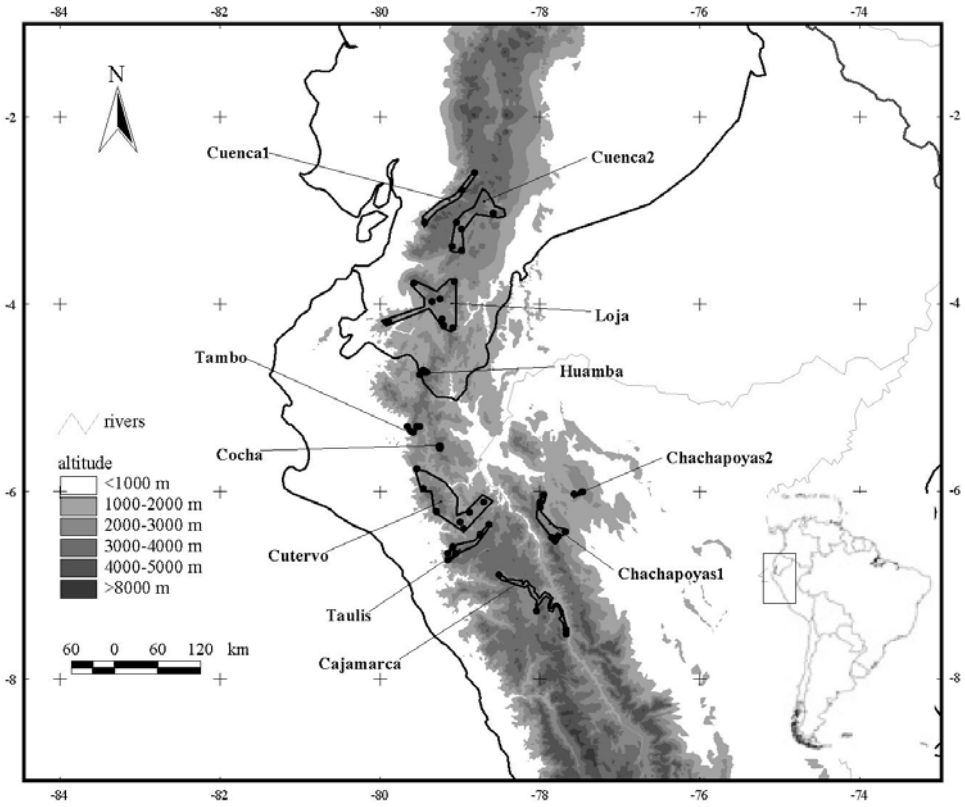


Figure 2.11.1. Geographic distribution of *C. iris*. The polygons represent the geographic pools, the dots the localities.

1.11.3 Geographic variation analysis

A total of 232 skins of *Coeligena iris* was reviewed (140 males and 92 females). The localities were grouped into 11 pools (Fig. 2.11.1). Below is the list of these pools and descriptions of the corresponding areas, ordered from north to south.

1. Cuenca1: located in the Cuenca region, central Ecuador, on the western slopes of the Andes, between 3000 and 3300 m a.s.l.

2. Cuenca2: located west of Cuenca1 pool, on the eastern slopes of the Andes, between 2500 and 3300 m.

3. Loja: located in Loja region, southern Ecuador, near the border to Peru, on the western slopes of the Andes, between 1100 and 3400 m.

4. Huamba: located on the border of Ecuador and Peru, separated from Loja and Tambo pools by deep river valleys. Altitudes between 2700 and 3100 m.

5. Tambo: located in the Tambo region in northern Peru, on the western bank of the River Huancabamba, western slopes of the Andes, between 1300 and 3000 m.

6. Cocha: located southwest of Tambo pool, on the east bank of the River Huancabamba, eastern slopes of the Andes, at 3150 m.

7. Cutervo: located on the Cutervo area in northern Peru, between the confluence of the Rivers Huancabamba, Chamaya and the River Marañon, between 1700 and 2700 m.

8. Taulis: located south of Cutervo pool, on the south bank of the River Saña, northern Peru, between 1700 and 2800 m.

9. Chachapoyas1: located in the surroundings of Chachapoyas, on the eastern bank of River Marañon, northern Peru, between 2100 and 3300 m.

10. Chachapoyas2: located near Molinopampa, directly northwest of Chachapoyas1, northern Peru, between 2400 and 3000 m.

11. Cajamarca: located at the headwaters of the River Chicama, south of Taulis, on the western bank of the River Marañon, between 2600 and 2900 m.

1.11.3.1 Morphometric variation

Coeligena iris males have shorter bills and longer wings and tails than the females, both sexes presenting significant differences in bill and tail-length, as well as in the tail fork-depth between the pools (Tab. 2.11.1, Fig. 2.11.3-4). Males from Chachapoyas pools (pools 9 and 10) have the shortest bills ($p<0.05$, males: 33.0-33.2 mm; females: 36.6-36.8 mm) and specimens from Cajamarca (pool 11) have the longest ($p<0.01$, males: 38.2±1.06 mm; females: 41.8±1.06 mm).

The longest tails were noted in specimens from Cuenca1 to Tambo (pools 1-5, $p<0.05$, males: 56.8-54.0 mm; females: 51.6-47.0 mm) and the shortest were found in specimens from Cocha and Cutervo to Cajamarca (pools 6-11, males: 50.9-52.7 mm; females: 44.4-47.0 mm). The most deeply forked tails were found in males from the northernmost pool Cuenca1 to Huamba

(pools 1-4, males 18.0-16.3 mm; females: 13.0-8.2 mm), the value being significantly lower from Tambo to Cajamarca (pools 5-11), with the latter having specimens showing the least deeply forked tails ($p<0.05$, males: 15.6-13.3 mm; females: 11.0-8.4 mm).

Males and females from Cajamarca (pool 11) have the longest wings, although the difference is not statistically significant ($p>0.05$ males: 82.4±2.35 mm; females: 76.7±2.88 mm), while males from Cocha and Cutervo (pools 6 and 7) showed relatively shorter wings (males: 78.4-79 mm; females: 74.4-73.1 mm).

Summarising, males and females from Cajamarca (pool 11) have the longest bills and wings, but relatively shorter and less deeply forked tails, whereas specimens from the isolated Chachapoya pools (9 and 10) had the shortest bill and the shortest and least deeply forked tails among the pools. There is a tendency for the males to have longer and more deeply forked tails in the northernmost pools (from Cuenca to Huamba, pools 1-4) than in the remaining southern pools; however, there is no statistical correlation with latitude.

1.11.3.2 Plumage variation

Plumage variation in *Coeligena iris* populations exhibits changes mainly in the crown coloration and the proportion of green on the upperparts. Groups of pools were formed according to the similarities. The first group is constituted by the pools Cuenca1 and Cuenca2 (1 and 2), with males showing the crown sides glittering metallic Chrome Orange 16 and the centre metallic very bluish Spectrum Violet 72, which extends transversally forming a patch on the hindcrown. The nape is bronzy black; upperparts Parrot Green 260 fringed Cinnamon 39; upper tail-coverts Raw Sienna 136. The chin is golden-greenish Chrome Orange 16; throat glittering Spectrum Green 62 with Turquoise 63 highlights, with a large central metallic Spectrum Violet 72 patch; underparts Parrot Green 260 fringed gold; lower belly Raw Sienna 136; under tail-coverts Raw Sienna 136. The tail feathers are Raw Sienna 136, with the innermost rectrix having Olive-Green 46 tips and the other outer rectrices with only the sides olive. The females are similar to the males, with the nape being less blackish; chin and throat scaly on white background; underparts Parrot Green 260 tipped white. The violet gular patch is absent.

The second group is formed by the pools Loja, Huamba, and Tambo (3-5), having the forecrown in males metallic Spectrum Green 62, turning more yellowish to yellowish Chrome Orange 16 on the hindcrown (in some cases blue feathers can be found); posterior border of the hindcrown violet Cobalt 68. The nape is black; upper back blackish Olive-Green 46 mixed

with Walnut Brown 221B; lower back and under tail-coverts reddish Walnut Brown 221B. The chin and throat are glittering Spectrum Green 62 fringed yellow on the chin; gular violet patch present with variable size (from 2 to more than 12 feathers); chest glittering dark Parrot Green 260; underparts and under tail-coverts reddish Mars Brown 223A mixed with black. The tail feathers are Walnut Brown 221B with olive tips reduced or absent. The females are similar to the males, the crown coloration being less glittering and with a scaly pattern, presenting occasionally a few blue feathers; nape bronze mixed with black or occasionally bronzy Olive-Green 46; upper back bronzy Olive-Green 46; lower back either completely reddish Walnut Brown 221B or reddish Walnut Brown 221B with dark Olive-Green 46 borders; upper tail-coverts reddish Walnut Brown 221B. The chin and throat scaly Spectrum Green 62, fringed turquoise, on buffy white background; chest yellowish Parrot Green 260 fringed Cinnamon 39; underparts Amber 36 mottled with black and white; under tail-coverts Amber 36. The rectrices are Walnut Brown 221B with only the sides olive.

The Cocha pool (6) forms by itself one distinct unit, with coloration differing essentially from the other groups. The crown in males is metallic Smalt-Blue 70-Cerulean Blue 67 with greenish and golden-reddish fringes; nape black; upperparts and upper tail-coverts Chestnut 32. The chin is glittering greenish Cerulean Blue 67; throat glittering Parrot Green 160; upper chest Parrot Green 160, rest of the underparts Chestnut 32 mottled with black; under tail-coverts pale Chestnut 32. The tail feathers are Chestnut 32 with the olive tipping extremely reduced or absent. Females are similar to males, with crown less metallic, green fringed with the hindcrown orange fringed. The nape is bronzy-greenish black; the upper back bronzy Olive-Green 46 mixed with Chestnut 32. The chin, throat and chest are scaly bluish Spectrum Green 62 on brownish white background.

The Taulis pool (8) represents an interesting unit, showing a high similarity with other pools in the crown coloration pattern. Males collected above 2500 m altitude showed the crown type observed in the pool group Loja-Huamba-Tambo (see above), with an extra blue patch on the hindcrown, whereas males collected below 2500 m altitude showed homogeneous metallic golden Chrome Orange 16 crown with a central Spectrum Blue 69 stripe, which can occasionally reach the hindcrown, this pattern being similar to that observed in males from the Cuenca group (pools 1 and 2) and Cajamarca (pool 11, see below). The remaining bodyparts are not different within the pool, the nape being very bronzy black; upper back bronzy Olive-Green 46; upperparts and upper tail-coverts Chestnut 32. The chin is glittering golden Spectrum Green 62; throat Parrot Green 160 with violet patch very reduced or absent (two or less feathers); underparts Chestnut 32 mottled with black; under tail-coverts very pale

Chestnut 32; rectrices Chestnut 32 with olive borders reduced or absent. The females did not show differences within the group, being very similar to the males from the higher altitude, with the nape more reddish with olive fringes. The chin and throat are scaly Spectrum Green 62 on tawny white background; chest glittering Parrot Green 260 mottled white.

The Cutervo (7) pool represents a heterogeneous mix of specimens with different coloration patterns that correspond to other morphologically more differentiated populations, probably representing a zone of contact (Fig. 2.11.1). Specimens from the northernmost locality (Porculla, Lambayeque, 1700 m altitude) have the same overall body coloration pattern as seen in the northern Loja-Huamba-Tambo group (pools 3-5); several specimens from the southern localities (Las Carpas, Santa Cruz, Cajamarca, 1700 m and Bosque de Cachil, Rio Chicama, Cajamarca, 2470 m) show a strong similarity to those from Taulis, above 2500 m altitude (pool 8). Specimens from the remaining localities (Loma Larga, Lambayeque, 2250-2390 m; Llama-Cascamba 2100-2400 m; Cutervo, 2650 m and Chira, Cajamarca, 2460 m) are indistinguishable from those from Cocha (pool 6).

The Cajamarca (11) pool also represents a distinguishable unit, with the males showing metallic golden-greenish Chrome Orange 16 crown sides and a central metallic Smalt-Blue 170 stripe, similar to the pattern observed in the Cuenca group (pools 1 and 2). The nape is very reddish-bronzy; upperparts bronzy-yellowish Olive-Green 46; upper tail-coverts Robin Rufous 340. The chin is yellowish Spectrum Green 62; throat glittering Spectrum Green 62 with turquoise fringes; gular violet patch absent; chest Parrot Green 260; underparts Robin Rufous 340; under tail-coverts Cinnamon 39. The tail feathers are Robin Rufous 340 with Olive-Green 46 borders. The females are very similar to the males, the crown being mainly brownish bronze. The chin and throat have glittering yellowish-golden scales on a tawny white background; chest glittering Parrot Green 260; underparts and under tail-coverts pale Robin Rufous 340, almost Cinnamon 39.

The two pools on the eastern bank of the River Marañon (Chachapoyas1 and Chachapoyas2, 9 and 10, respectively) represent one unit, the overall aspect in males being similar to that observed in the northern group Loja-Huamba-Tambo (pools 3-5). The crown is metallic Chrome Orange 16, occasionally with some blue feathers near the bill or with a clear central line; hindcrown with patch violet Cobalt 68; nape black fringed glittering reddish

bronze; upper back like the nape, mixed with dark Olive-Green 46; lower back and upper tail-coverts Tawny 38. The chin and throat are metallic bluish Spectrum Green 62 fringed turquoise and yellow; the violet gular patch is of variable size, sometimes being absent;

underparts and under tail-coverts Tawny 38. The rectrices are Mars Brown 223A with olive tips reduced or absent. The females show a crown with mixed green-becoming-scarlet, very similar to the pattern observed in males from Loja-Huamba-Tambo but with the base of the feathers black, conferring a scaly aspect; nape very bronze, with almost no black; upper back Olive-Green 46 fringed bronze and gold; lower back and upper tail-coverts Tawny 38. The chin and throat are scaly metallic Spectrum Green 62 fringed turquoise on a brownish white background; chest glittering bluish Parrot Green 260; underparts and under tail-coverts Tawny 38. The rectrices are Tawny 38 with very marked olive tips.

1.11.4 Discussion

The northernmost pool group, formed by the Cuenca population (pools 1 and 2), corresponds taxonomically with the subspecies *Coeligena iris hesperus* (Gould, 1865), being characterised by the relatively longer bill, the fiery orange-blue crown coloration, the overall dark green colour on the upperparts and underparts and the large violet patch on the chest. These populations are effectively isolated from the contiguous pools by high mountain ranges and the valley of the River Jubones (Fig. 2.11.2).

The group formed by the pools Loja, Huamba and Tambo (3-5), corresponds with the nominate race, *Coeligena iris iris* (Gould, 1853) and represents the 'typical' form of the species.

The populations have relatively long to intermediate-sized bills and tails, being easily recognisable by the green-becoming-scarlet coloration on the crown, the black-olive nape and upper back and the reddish brown coloration on the rest of the body. These populations seem to range southwards, along the western bank of the River Huancabamba, reaching the Cutervo region (Fig. 2.11.1-2). This was corroborated by the presence of specimens with the coloration pattern described in Cutervo (pool 7, see below).

To the morphotype described for Cocha (pool 6) has been given the name *Coeligena iris aurora* (Gould, 1853). This group has tail and wing relatively shorter and several important unique characteristics in the coloration: the crown, chin and throat in both sexes are metallic blue, with some greenish fringes, the violet patch being completely absent. The black coloration is restricted to the nape, the body being overall reddish brown. As in the group named *C. i. iris*, specimens corresponding to this coloration pattern were also found in the Cutervo pool (pool 6; Fig. 2.11.1-2).

Neither evidence of hybridisation nor geographic or altitudinal barriers that separate or isolate the Cutervo pool from the other pools were found, so it is reasonable to assume complete sexual isolation of the '*aurora*' form (Fig. 2.11.2), which occurs in sympatry with two other races of *C. iris* (*C. i. iris* and *C. i. eva*, see below), separating them from each other. For this reason I propose to promote this taxon to species level: *Coeligena aurora* (Gould, 1853).

The Taulis (8) pool includes specimens with mixed crown coloration patterns, which seems to be dependent on the altitude. Specimens from lower altitudes showed similarities in the crown coloration with the pattern observed in the Cajamarca pool (11), whereas those from higher altitudes showed closer similarities in the crown coloration pattern to that found in specimens from the Loja-Tambo-Huamba group (pools 3-5) and north of Cutervo (pool 6). The remaining bodyparts have the appearance of an intermediate pattern between the two neighbourimg populations. Zimmer (1951) gave the name *Coeligena iris flagrans* Zimmer, 1951 but after according to this present analysis, no diagnostic character was found that permits a clear identification of this group as distinct. Thus the distribution assigned to *C. i. flagrans* Zimmer, 1951 should be considered as the intergradation zone of *C. i. iris* (Gould, 1853) with *C. i. eva* (Salvin, 1897) (Fig. 2.11.2).

The Cutervo pool (6) includes specimens corresponding to three different subspecies of *C. iris*, therefore represents a zone of contact between *C. iris* and *C. aurora*, evidenced by the geographic mosaic of morphotypes.

The group Chapapoyas, on the eastern bank of the River Marañon (pools 9 and 10), corresponds taxonomically with the subspecies *Coeligena iris fulgidiceps* (Simon, 1921), showing high affinities with the groups on the western bank of the Marañon (Fig. 2.11.2). Although being quite distinct from the specimens on the western bank of the River Marañon because of the general smaller size (the shortest bills and shortest and least deeply forked tails), the coloration pattern resembles a mixture of the western forms, with the crown diagnostically metallic golden orange; the bodyparts are similar to those observed in the specimens from Loja-Tambo-Huamba pool group; the gular patch is present, with variable size.

Tab. 2.11.1. Descriptive statistics of the morphometric parameters in *C. iris* and *C.aurora* (Cutervo pool). The pools are ordered geographically from north to south (see text for details)

Morphometric parameter	Pools	Cuenca1	Cuenca2	Loja	Huamba	Tambo	Cocha	Cutervo	Taulis	Chachapoyas1	Chachapoyas2	Cajamaraca
Bill-length (mm)	♂											
	Mean	36.6	35.8	34.7	35.5	35.1	33.6	34.5	35.6	33.0	33.2	38.2
	±S.D.	0.20	1.00	1.33	0.73	1.34	1.08	2.06	1.20	1.44	0.67	1.06
	Max.	35.8	37.8	37.7	37.2	36.2	34.5	39.7	38.4	35.0	33.9	38.9
	Min.	35.4	34.3	32.7	34.2	32.9	32.1	31.2	33.7	29.2	32.1	37.4
	N	3	12	13	24	5	4	32	11	15	8	2
	♀											
	Mean	39.0	37.9	36.8	37.6	37.8	36.1	38.0	39.4	36.8	36.6	41.8
	±S.D.	0.78	1.74	0.98	0.92	0.71	1.30	1.68	1.16	0.94	0.49	1.06
	Max.	39.6	41.1	38.0	38.7	38.5	37.4	41.4	41.01	38.1	37.0	42.6
	Min.	38.5	35.2	35.8	35.2	36.7	34.8	35.3	38.2	35.0	36.3	40.0
	N	2	12	4	14	5	3	26	4	9	2	5
Wing-length (mm)	♂											
	Mean	80.1	81.8	80.6	82.2	80.0	78.4	79.0	80.5	80.2	80.9	82.4
	±S.D.	1.72	2.04	3.14	2.44	1.42	1.30	2.84	1.80	2.48	0.75	2.35
	Max.	82.1	85.1	86.2	85.4	82.5	80.3	86.4	82.7	84.0	82.3	84.7
	Min.	78.9	78.5	74.4	78.2	78.2	77.4	72.7	78.0	74.8	80.1	80.0
	N	3	13	15	25	6	4	33	8	15	7	3
	♀											
	Mean	75.6	78.2	72.4	76.4	74.8	73.1	74.4	75.2	73.3	73.0	76.7
	±S.D.	5.00	3.82	1.08	1.90	0.78	0.70	2.42	0.79	1.82	2.12	2.88
	Max.	81.3	87.5	73.5	80.3	75.6	73.8	78.4	76.3	76.6	74.5	80.7
	Min.	71.8	72.9	70.9	74.0	73.8	72.4	69.7	74.5	71.0	71.5	73.0
	N	3	13	4	13	6	3	26	4	9	2	5
Tail-length (mm)	♂											
	Mean	56.7	56.7	54.8	56.8	54.0	51.2	50.9	52.2	51.6	51.2	52.7
	±S.D.	2.76	1.82	3.6	1.68	1.32	1.42	3.03	1.50	3.40	1.68	1.98
	Max.	59.1	59.3	59.5	60.5	55.5	52.6	55.4	54.3	58.8	53.6	54.9
	Min.	53.7	54.2	45.9	54.0	52.7	49.2	40.5	49.7	47.9	48.9	51.0
	N	3	12	13	25	5	4	30	11	14	8	3
	♀											
	Mean	49.0	51.6	47.0	49.6	48.2	44.4	45.8	47.8	46.4	45.0	47.0
	±S.D.	2.90	4.22	2.20	1.36	1.21	1.76	1.78	1.26	2.22	0.42	3.02
	Max.	52.4	62.4	49.3	51.1	49.9	45.9	48.3	49.2	50.0	45.3	51.0
	Min.	47.1	45.7	44.9	46.5	46.7	42.5	40.9	46.3	42.7	44.7	43.1
	N	3	12	4	14	6	3	24	4	9	2	5
Tail Fork-Depth (mm)	♂											
	Mean	17.4	17.10	16.3	18.0	15.6	14.2	13.7	15.0	14.0	14.2	13.3
	±S.D.	3.25	2.02	2.48	1.72	1.48	1.50	2.58	1.53	2.88	1.36	0.95
	Max.	20.7	19.9	21.3	21.6	17.4	15.6	17.5	17.2	21.5	15.7	14.3
	Min.	14.2	14.0	12.8	14.8	14.3	12.1	4.2	12.6	11.2	11.5	12.4
	N	3	11	12	24	4	4	29	9	14	8	3
	♀											
	Mean	10.8	13.0	8.2	10.8	11.0	8.6	8.8	10.4	8.7	8.4	8.4
	±S.D.	3.19	3.90	1.66	1.62	1.22	1.78	1.52	1.20	2.30	0.92	3.64
	Max.	14.4	22.9	10.0	12.8	13.1	10.7	11.0	12.2	11.5	9.0	14.4
	Min.	8.4	8.7	6.7	7.3	10.1	7.4	6.2	9.6	5.1	7.7	4.9
	N	3	12	3	14	5	3	23	4	9	2	5

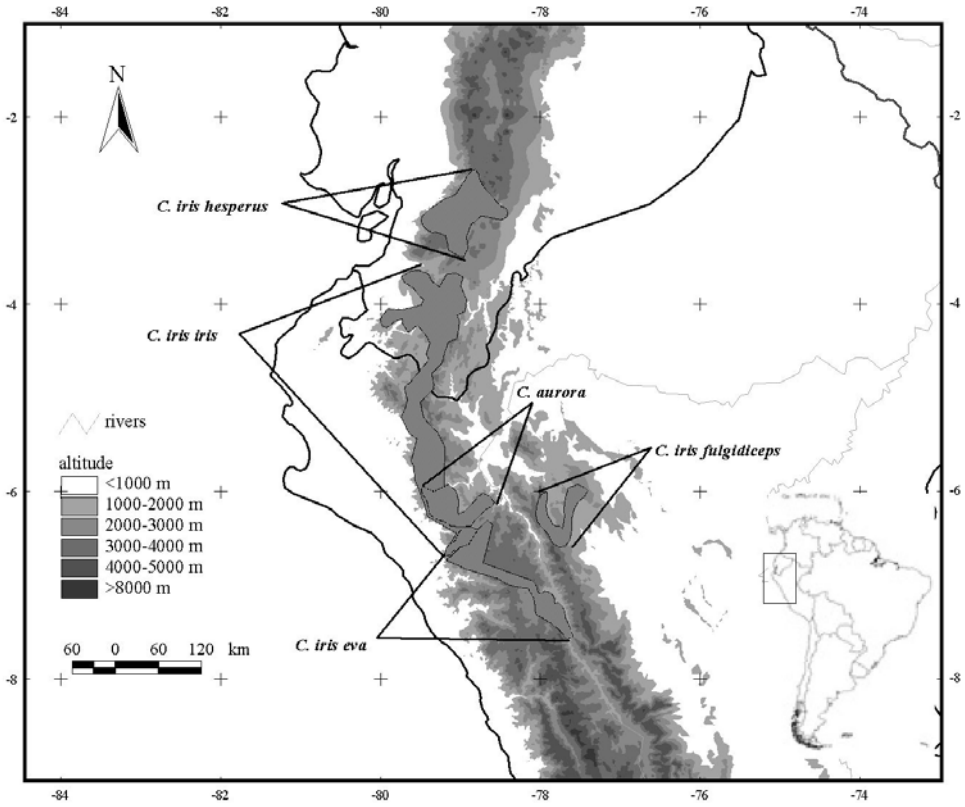
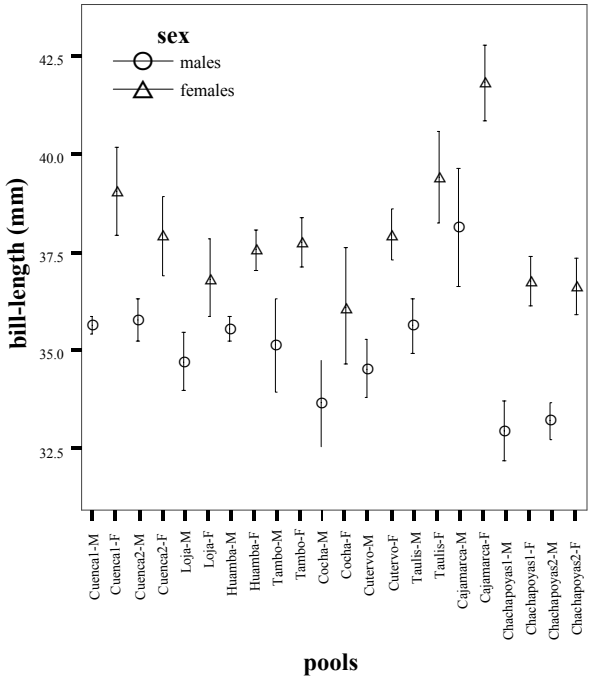


Figure 2.11.2. Geographic distribution of *C. iris* and *C. aurora*. The subspecies ranges of *C. iris* (recognised in this study), and the range of *C. aurora* are represented by filled polygons. Note the zone of contact between the two species (see text for details).

Despite this mixture of characters, it is not possible to assume contact between the pools in the west, the deep valley of the River Marañon presenting a very important geographic barrier.

Finally, the southernmost pool Cajamarca (11) corresponds with the subspecies *Coeligena iris eva* (Salvin, 1897), being morphometrically distinguishable by the long bills and wings, and shorter and less deeply forked tails. This group exhibits a crown coloration pattern very similar to that observed in the northernmost group in Cuenca (pools 1 and 2), differing in the more greenish base colour. The diagnostic characters of the group include: the absence of black on the nape and upper back, the absence of the violet gular, patch and the well-developed olive tips on the tail feathers (Fig. 2.11.2).



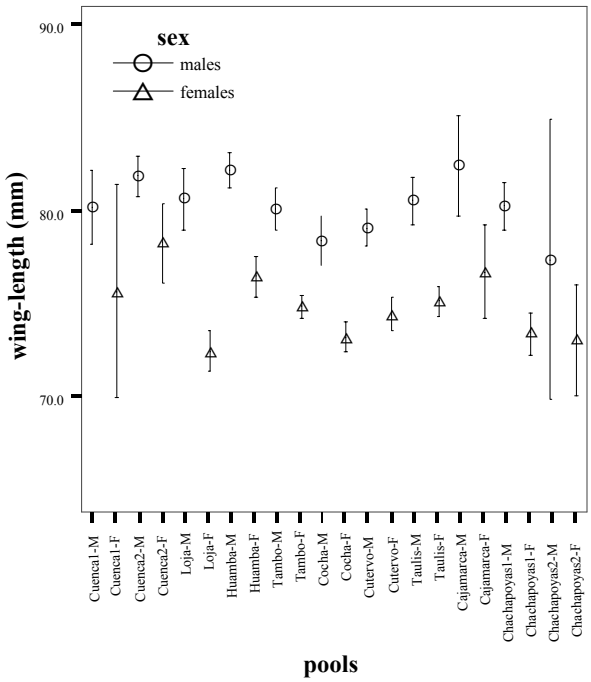


Figure 2.11.3. Geographical variation of the bill- and wing-length in *C. iris* and *C. aurora*. The circle and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. *C. aurora* is represented by the pool "Cutervo". Pools are ordered geographically from north to south.

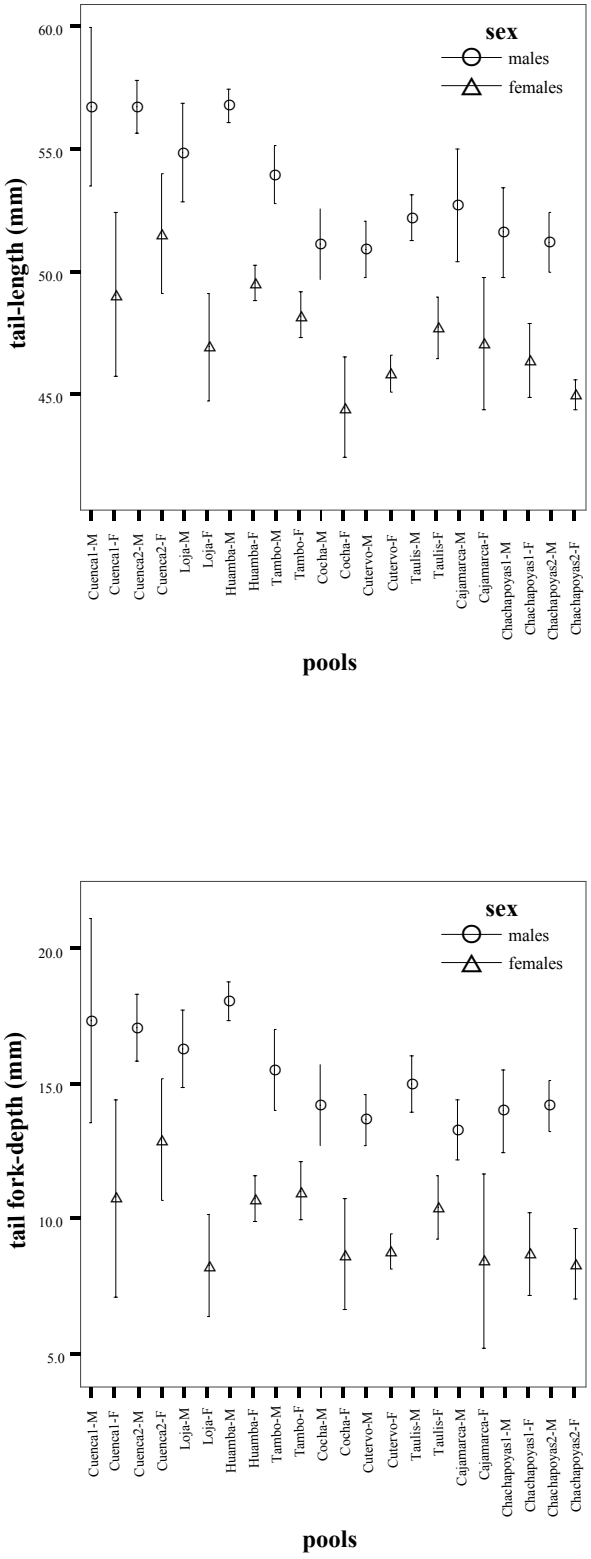


Figure 2.11.4. Geographical variation of the tail-length and tail fork-depth in *C. iris* and *C. aurora*. The circle and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. *C. aurora* is represented by the pool "Cutervo". Pools are ordered geographically from north to south.

1.12 *Coeligena inca* (Gould, 1852)

1.12.1 Geographic distribution and taxonomy

Coeligena inca range is restricted to the south-eastern Peru and north-eastern Bolivia, on the western slopes of the Andes (Fig. 2.12.1). Two subspecies are currently recognised (Schuchmann 1999), *C. i. omissa* and *C. i. inca*. The first inhabits the mountain ranges on the eastern bank of the River Ucayali, near the border with Bolivia; *C. i. inca* occurs in the region of La Paz and Cochabamba, south of the River Madre de Dios, north-eastern Bolivia.

The taxonomy of the species is not completely clear; it often considered to be closely related to *Coeligena torquata* and they are often merged together. The first known specimen of *C. inca* is an immature male from Coroico, Bolivia, from 3000 or 4000 m a.s.l., described by Gould (1852) as *Bourcieria inca* (altitude data was later added by Gould in 1854). Because of the specimen's immaturity, Gould suggested that the adult plumage would not differ much from the immature, and remarked on the similarities of this taxon with *Trochilus conradi* Bourcier, 1847; *T. torquatus* (Boissonneau, 1840) and *T. insectivorus* Tschudi, 1844 in body size and coloration.

Later taxonomic revisions made no changes at the generic level (Elliot 1876, Gould 1854, Reichenbach 1853). Hartert (1900) placed the taxon within *Helianthea* Gould, 1848. Simon (1921) listed the taxa under the genus *Bourcieria* Bonaparte, 1850, and included the species *Bourcieria inca* Gould, 1852, without mentioning Hartert's (1900) arrangements.

Peters (1945) considered the species as a geographic race of *Coeligena torquata* (Boissonneau, 1840), *Coeligena t. inca* (Gould, 1852), emphasising the problematic taxonomy. Zimmer (1948) did find enough distinction between Peruvian and Bolivian *Coeligena* (*torquata*?) *inca* specimens and named the Peruvian population *Coeligena torquata omissa*, with type locality Huaisampillo ["Huasampilla"], south-eastern Peru; altitude 9000 feet [*c.* 3000 m] (adult male collected by H. Whitely in April, 1872 and deposited in the American Museum of Natural History, New York). Zimmer resolved the problems of the group outlined by Peters (1945) with the inclusion of both taxa in *Coeligena torquata* (Boissonneau, 1840), but the uncertainty of the best taxonomic placement remains unsolved.

Recently, Schuchmann (1999) presented *Coeligena inca* (Gould, 1852) as a valid species, based on morphological and distributional characteristics. The species includes two races: *C i. omissa* (Zimmer, 1948) and the nominate *C. i. inca* (Gould, 1852). However the status of the

taxon remains unclear, one example being the taxonomic list presented by Peterson (1996), where *inca* is omitted, presumably included in *torquata.*

For the purpose of this study, *Coeligena torquata* (Boissonneau, 1840) and *Coeligena inca* (Gould, 1844) were considered as separate entities (*sensu* Schuchmann 1999), but the close morphologic relationship is obvious, and it is very probable that *C. inca* and the species complex *C. torquata* represent a superspecies. This topic will be discussed in the section on phylogenetic relationships.

1.12.2 Diagnosis

Coeligena inca is a relatively large-sized, dimorphic species that shows a very high resemblance to *Coeligena torquata* in many plumage features. The males have long, straight, black bills. The head is blackish, fringed gold and green; crown with only one very yellowish Sky Blue 173 frontal spot. The upperparts are golden Parrot Green 160, becoming more shiny greenish on the lower back; upper tail-coverts yellowish Parrot Green 260. The throat is black with washed golden Spectrum Green 62 discs, that become more shiny on the anterior edge of the pectoral collar; pectoral collar feathers white at the base and Amber 36 on the tips. Underparts glittering golden Parrot Green 160 with bluish fringes; under tail-coverts Parrot Green 160 tipped brownish white. The tail is forked with inner rectrices golden Parrot Green 160 and the others white with contrasting golden Parrot Green 160 tips varying in size. Females have longer bills than males; head blackish Parrot Green 260 forming small discs; greenish blue crown spot present; rest of the upperparts shining golden green. The chin and throat are Amber 36 with sides bluish Spectrum Green 62; pectoral collar like throat, without white. The underparts washed Cinnamon 39, sides with discs golden Spectrum Green 62. The tail is less deeply forked. Immatures are similar to adult females with head feathers fringed buffy (Buff 124) but the crown spot is absent.

1.12.3 Geographic variation analysis

A total of 39 skins of *Coeligena inca* (23 males and 16 females) was examined. The localities were grouped in four geographic pools (Fig. 2.12.1). There follows a list of these pools and the descriptions of the corresponding areas they occupy, ordered from north to south.

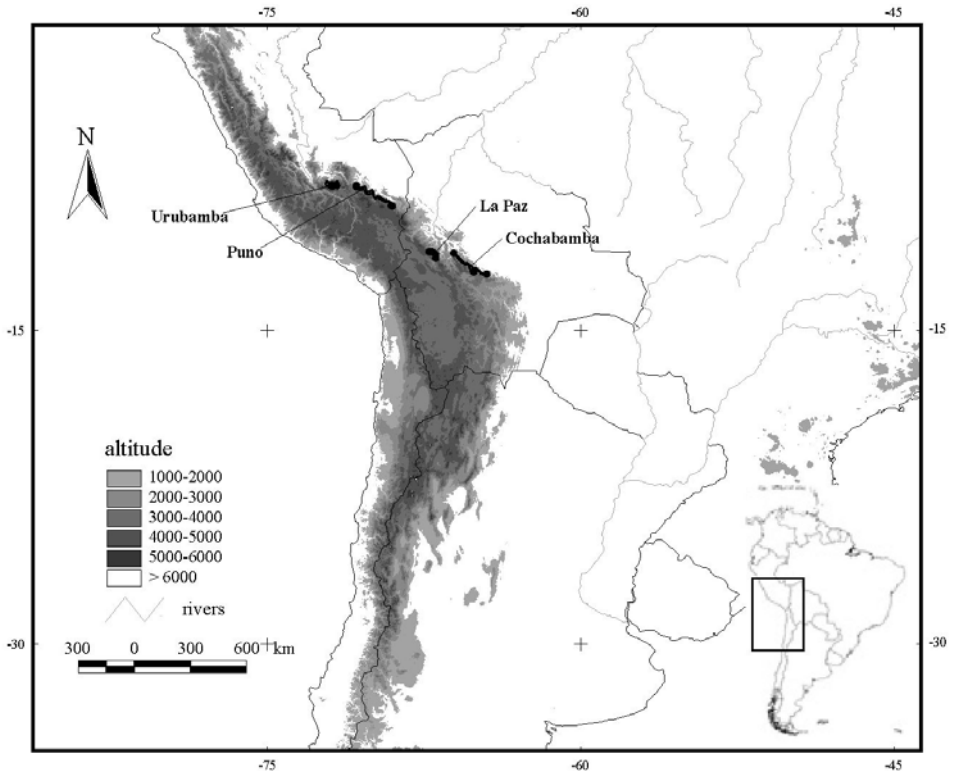


Figure 2.12.1. Geographic distribution of *C. inca*. The polygons represent the geographic pools, the dots the localities.

1. Urubamba: located north-east of Cuzco, on the east bank of the River Apurímac, southern Peru, between 1650 and 3300 m a.s.l.

2. Puno: located north-west of Lake Titicacaca, in southern Peru, near the border with Bolivia, between 1950 and 3100 m.

3. La Paz: located south of Lake Titicaca, in the Cordillera Real range, northern Bolivia, between 2400 and 2750 m.

4. Cochabamba: located in in the Bolivian Yungas, Cordillera Cochabamba range, northern Bolivia, between 2400 and 2750 m.

Table 2.12.1 Descriptive statistics of the morphometric parameters in *C. inca*. The pools are ordered geographically from north to south.

Morphometric parameters	Pools	Urubamba	Puno	La Paz	Cochabamba
bill-length (mm)	males				
	mean	39.2	37.1	38.6	38.0
	±S.D.	0.84	0.38	0.95	1.29
	Max.	40.1	37.4	39.8	39.9
	Min.	38.3	36.7	37.1	35.6
	N	4	3	8	8
	females				
	mean	39.8	40.0	39.2	40.1
	±S.D.	1.48	1.52	1.56	0.64
	Max.	40.8	41.4	40.3	40.8
	Min.	38.7	37.5	38.1	39.7
	N	2	6	2	3
wing-length (mm)	males				
	mean	76.0	75.4	76.0	75.2
	±S.D.	1.76	1.48	2.04	3.04
	Max.	78.5	77.5	79.2	79.8
	Min.	74.6	74.0	73.5	68.3
	N	5	6	9	10
	females				
	mean	69.6	70.4	70.2	70.9
	±S.D.	1.06	1.44	0.56	0.99
	Max.	70.3	73.5	70.6	72.1
	Min.	68.8	69.3	69.8	70.1
	N	2	7	2	4

1.12.3.1 Morphometric variation:

Coeligena inca has a marked morphometric dimorphism (Tab. 2.12.1, Fig. 2.12.3-4). Males have shorter bills, longer wings and longer, more deeply forked tails than the females ($p<0.01$, bill-length: males 38.2±1.14 mm, females 39.8±1.23 mm; wing-length: males 75.6±2.24 mm, females 70.4±1.18 mm; tail-length: males 46.2±2.65 mm, females 41.6±0.83 mm; tail fork-depth: males 4.6±1.92, females 1.4±1.17). None of the measured variables showed significant differences between pools.

Table 2.12.1. (Continued) Descriptive statistics of the morphometric parameters in *C. inca*. The pools are ordered geographically from north to south.

Morphometric parameters	Pools	Urubamba	Puno	La Paz	Cochabamba
tail-length (mm)	males				
	mean	48.0	45.8	46.2	45.7
	±S.D.	2.14	3.67	1.62	2.92
	Max.	49.8	49.8	48.5	49.9
	Min.	44.8	39.9	43.9	39.1
	N	5	6	9	10
	females				
	mean	40.9	42.1	41.4	41.4
	±S.D.	0.98	0.62	1.27	0.80
	Max.	41.6	42.9	42.3	42.6
	Min.	40.2	41.0	40.5	40.7
	N	2	7	2	4
tail fork-depth (mm)	males				
	mean	5.6	4.2	5.2	4.0
	±S.D.	2.04	1.71	0.65	2.53
	Max.	8.4	5.8	6.4	8.6
	Min.	3.5	1.6	4.4	-0.7
	N	4	6	8	10
	females				
	mean	0.2	2.0	0.9	1.6
	±S.D.	0.07	1.38	0.98	0.32
	Max.	0.2	4.1	1.6	1.8
	Min.	0.1	0.4	0.2	1.2
	N	2	6	2	3

1.12.3.2 Plumage variation

Coeligena inca has a homogeneous coloration pattern througout its range (see description in Diagnosis). The pools Urubamba (1) and Puno (2) did not show any detectable difference in plumage coloration. The males of both pools show a very blackish head fringed Dark Green 162A, with one frontal glittering greenish Turquoise Blue 65 crown spot. The nape is blackish Dark Green 162; upperparts golden Parrot Green 160 fringed turquoise. The innermost tail feather is yellowish Olive Green 50; the other rectrices white, with olive restricted to the tips. The chin and throat are blackish-bronzy Parrot Green 160; collar Amber 36 with white; underparts bluish Parrot Green 160; under tail-coverts yellowish Olive Green 50. The females

are similar to the males. The head is dark Parrot Green 160 with one crown spot similar to the males; upperparts yellowish Parrot Green 260; upper tail-coverts yellowish Olive Green 50. Tail similar to the males'. The chin and throat are scaly yellowish Parrot Green 160 laterally, and medially Amber 36; the pectoral collar has the same colour as the throat. The underparts are scaly blackish-bluish Parrot Green 260; under tail-coverts bluish Parrot Green 160.

The pools La Paz (3) and Cochabamba (4) showed very few differences from the two pools described above. The more evident variation was found in male crown, being more bluish, Cobalt Blue 68-Sky Blue 66, in these pools than in the Peruvian pools. The chin and throat have no bronze, being more golden-blackish Parrot Green 260. The pectoral collar and throat are separated by a glittering golden Spectrum Green 62 band; underparts and under tail-coverts more bluish Parrot Green 160. Females of both Peruvian and Bolivian pools are practically identical, presenting only minor variations, like less bluish on the underparts and more yellowish on the upperparts of the Bolivian pools.

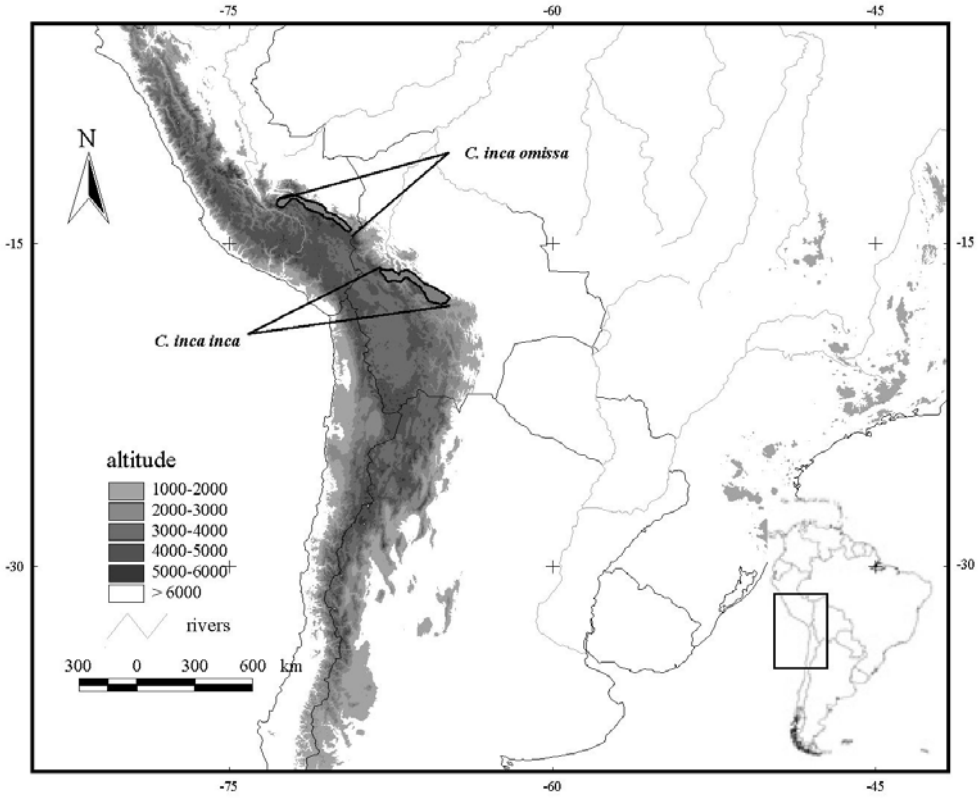
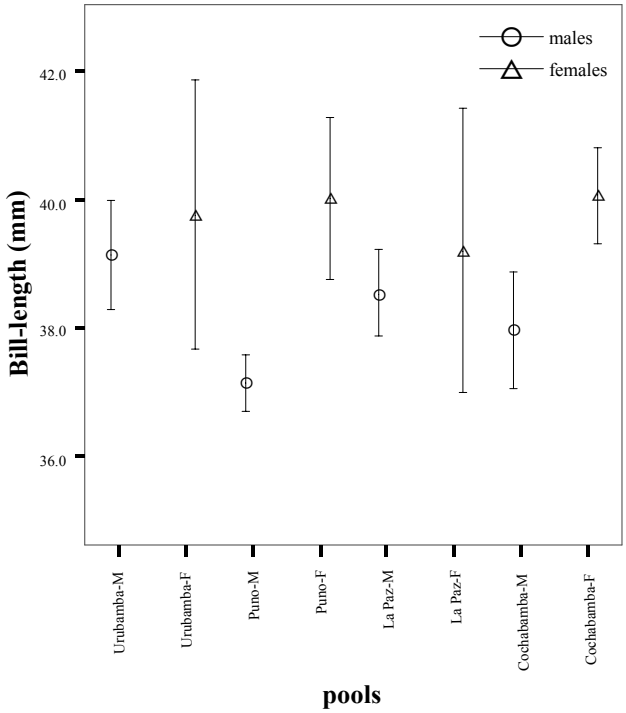


Figure 2.12.2. Geographic distribution of *C. inca*. The subspecies ranges are represented by filled polygons.

1.12.4 Discussion

The *Coeligena inca omissa* holotype was collected in Huansampillo, south-eastern Peru, the specimens from the pools Urubamba and Puno belonging to this taxonomic group, whereas *Coeligena inca inca* was described from the north-east of Bolivia, corresponding with the pools La Paz and Cochabamba (Fig. 2.12.2). Zimmer's (1948) description of *C. i. omissa* states that the most important differences found between the two races consisted in the amount of green on the throat; the more greenish tinges on the head; the amount of bluish hue in the frontal crown spot; the much slighter rufous hue on the breast, and the darker green on the back and underparts; the females are not distinguishable, but in the light of morphometric and plumage characteristics the validity of the race *C. i. omissa* is questionable. Geographically it is not supported either, because the valley of the River Madre de Dios could hardly act as an effective barrier to the dispersal of these birds.

Unfortunately, there are not many specimens of this species in order to determine if the gap between the northern and the southern populations is not caused by poor sampling in the region. For the moment I suggest maintaining the name *C. i. omissa* for the Peruvian subpopulations until more evidence to the contrary is found.



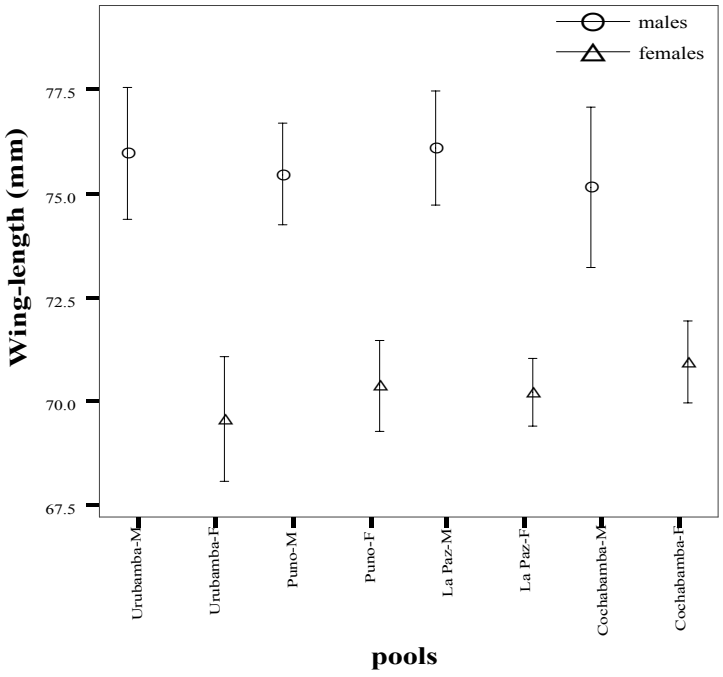


Figure 2.12.3. Geographic variation of the bill- and wing-length in *C. inca*. The circles and triangles represent the arithmetic mean of males and females, respectivela; and the vertical line the standard error of the mean. Pools are geographically ordered from north to south.

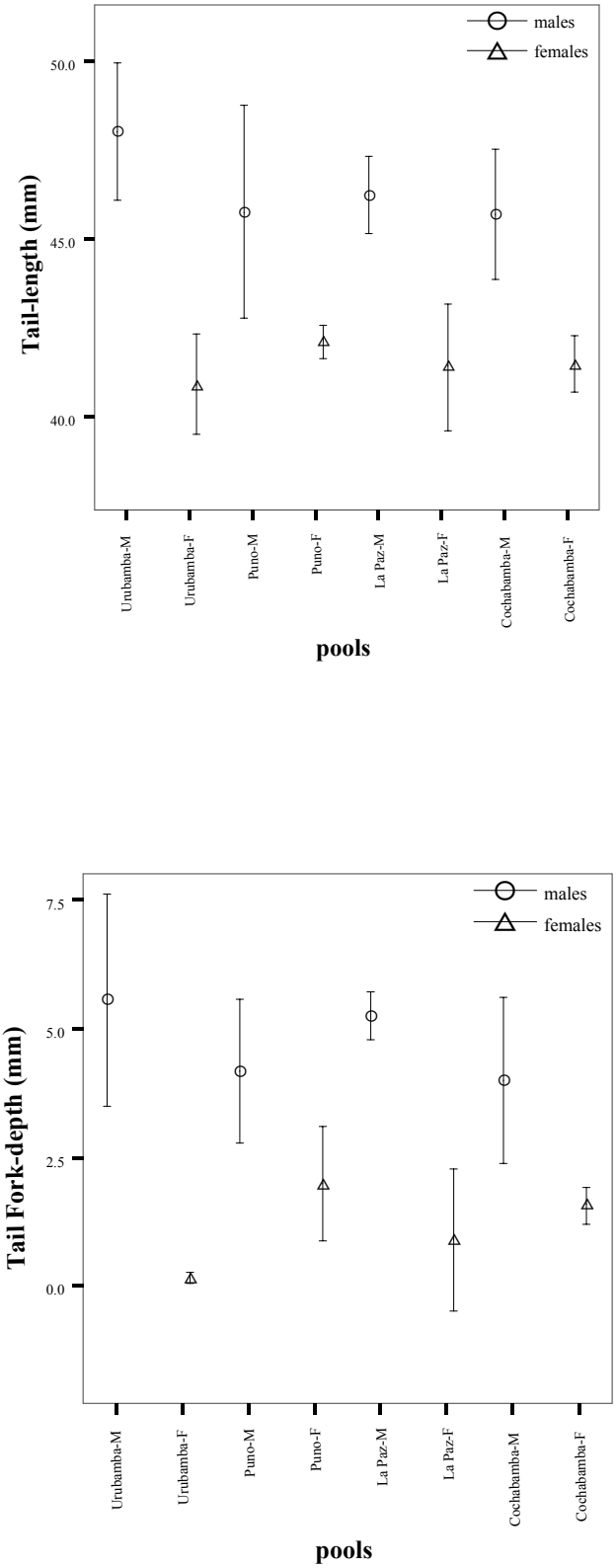


Figure 2.12.3. Geographic variation of the tail-length and tail fork-depth in *C. inca*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical line the standard error of the mean. Pools are geographically ordered from north to south.

2. Genus *Pterophanes* Gould, 1849

Pterophanes is a monotypic genus with sexually dimorphic individuals, having a cylindrical to laterally compressed, slightly upward-curved bill longer than the head and partially feathered (not reaching the nostrils); wings very long and curved, reaching the tail tip; tail long and very forked; tarsi feathered; feet small and well developed; hind toe shorter than the middle one (Elliot 1878, Gould 1861, Hartert 1900).

The genus *Pterophanes* was erected by Gould (1849) with *Ornismya Temminckii* Boissoneau 1839 as type species.

2.1 *Pterophanes cyanopterus* (Fraser, 1840)

2.1.1 Taxonomy and Distribution

The range of *Pterophanes cyanopterus* extends from the northern half of the East and Central Andes through Ecuador and Peru, on the eastern Andean slopes, to the Yungas of Cochabamba, in north-eastern Bolivia (Fjeldså & Krabbe 1990, Schuchmann 1999), with some isolated populations on the western slopes of the Peruvian Andes in Zárate, Dept. of Lima, at 3000 m a.s.l. (Koepcke 1970, Fig. 2.13).

Three races are recognised: the nominate form, from the northern East and Central Andes of Colombia; *P. c. caeruleus* from the Central and West Andes of southern Colombia, and *P. c. peruvianus* from Ecuador to north-eastern Bolivia. The only species in the genus was described by Boissonneau (1839) as *Ornismya Temminckii* as type species, reported from Santa Fe de Bogota. Fraser (1840) described exactly the same taxon as Boissoneau (1839) from the same locality (Bogota) as *Trochilus cyanopterus*, but Boissonneau's name prevailed, being the taxon classified as *Pterophanes temmincki* in later works (e.g., Bonaparte 1850; Chapman 1917; Elliot 1878; Gould 1849; 1861; Hartert 1900; Reichenbach 1853).

Boucard (1895) described a distinct form of *Pterophanes* from Peru and Bolivia and named it *P. peruvianus*, and later, Bangs & Penard (1919) exposed the invalidity of the name *Ornismya Temminckii* Boissonneau 1839, because of the preoccupation of the name, which was actually a synonym for *Heliomater squamosus*, and adopted Fraser's (1840) given name *Pterophanes cyanopterus*, which is the current situation (Chapman 1926, Peters 1945, Simon 1921).

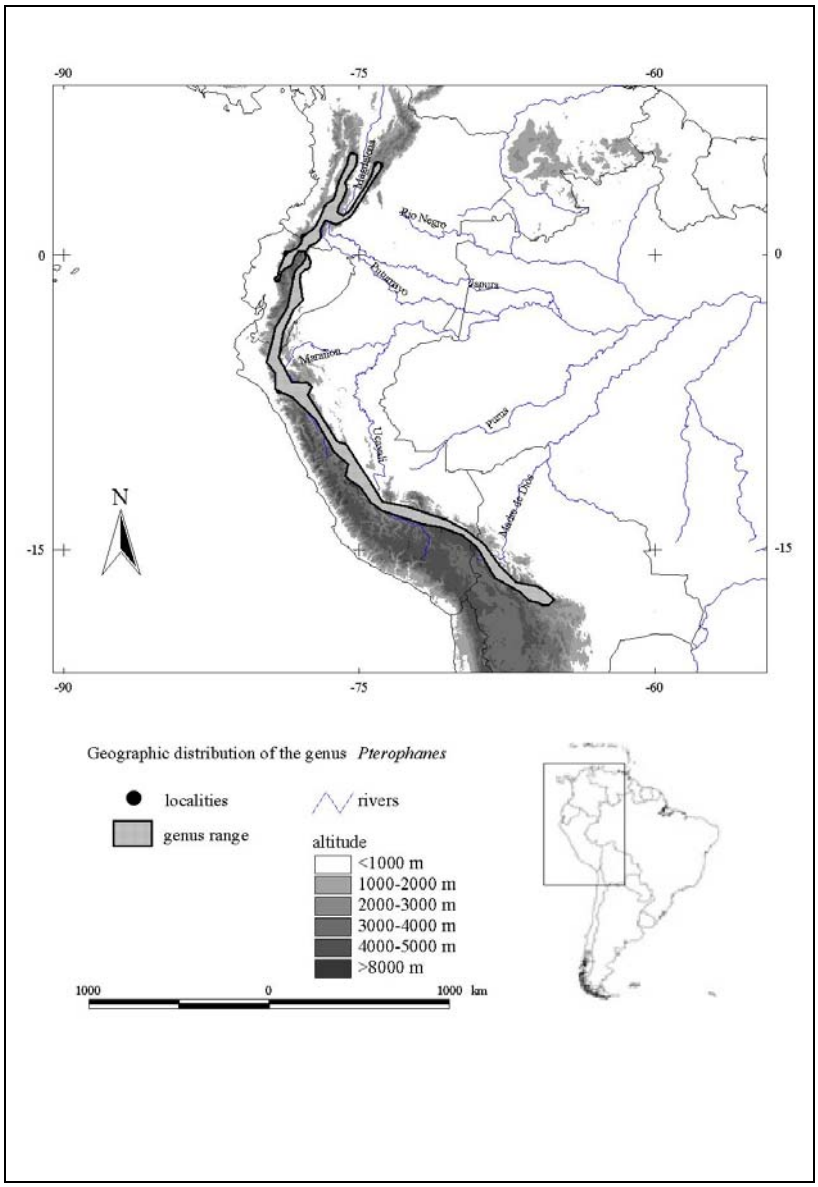


Figure 2.13. Geographic distribution of the genus *Pterophanes*.

More recently, Zimmer (1951b) reported a new subspecies, *P. cyanopterus caeruleus*, from Nariño, in southern Colombia, bringing to three the number of currently recognised subspecies of *Pterophanes cyanopterus* (Schuchmann 1999).

2.1.2 Diagnosis

Pterophanes cyanopterus comprises very large-sized, sexually dimorphic individuals, with males having head and upperparts Dark Green 262; head with white postocular spot; upper tail-coverts Leaf Green 146. The chin, throat and underparts have a mixture of Cyan 164 and

Spectrum Green 62 fringed Ultramarine 270; under tail-coverts Turquoise Green 64. The rectrices are Leaf Green 146; wing-coverts bluish Turquoise Green 64; primaries Ultramarine 270 with Indigo Blue 173, each secondary with two-thirds Ultramarine 270 with Indigo Blue 173 and one third Raw Umber 223. The females are similar to the males, with head Olive-Brown 28; underparts Cinnamon 39 medially and glittering Spectrum Green 62 laterally; under tail-coverts Emerald Green 163; innermost rectrix Emerald Green 163, remaining rectrices Dark Brownish Olive 129, outermost rectrix Raw Umber 223 laterally with white.

2.1.3 Geographic variation analysis

A total of 103 specimens of *Pterophanes cyanopterus* (71 males and 32 females) was analysed and grouped into 12 geographic pools, which are listed from north to south:

1. Bogota: located in the vicinity of Bogotá, Colombia, above 3000 m a.s.l.

2. Tolima: located in the Nevado de Tolima, Caldas region, on the Central Andes, central Colombia, at 3600 m.

3. Cauca: located near Popallán, on the western slope of the West Andes, southern Colombia, between 3000 and 3700 m.

4. Nariño: located near the Nevado de Cumbal, at the border of Colombia and Ecuador, on the western slopes of the Andes, between 3000 and 3400 m.

5. Pichincha: located in the surroundings of the Pichincha Volcano, on the western slopes of the Ecuadorian Andes, between 2800 and 3700 m.

6. Papallacta: located in the vicinity of Papallacta, on the eastern slopes of the Ecuadorian Andes, at 4600 m.

7. Santo Domingo: located near Santo Domingo de los Colorados, on the western slopes of the Ecuadorian Andes, above 2000 m.

8. Huancabamba: located between Huancabamba and Cutervo, on the western bank of the River Marañon, in northern Peru, between 2200 and 3600 m.

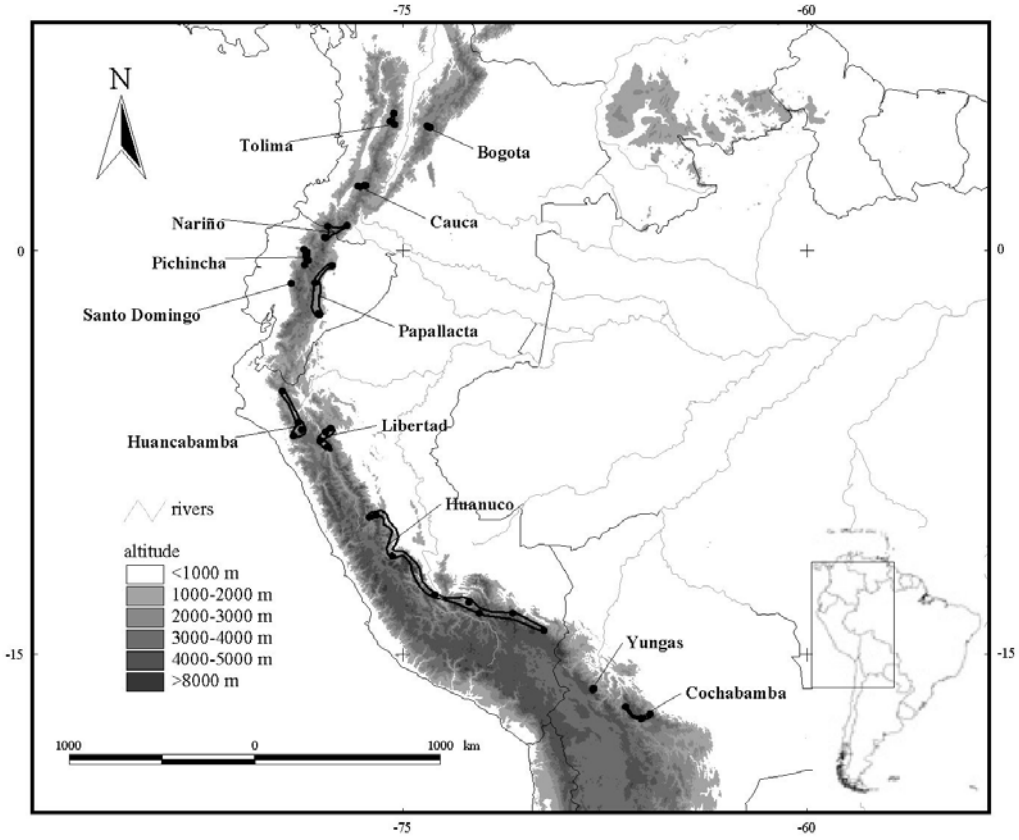


Figure 2.13.1. Geographic distribution of *Pterophanes cyanopterus*. The polygons represent the geographic pools, the dots the localities.

9. Libertad: located south of Leimabamba, on the eastern bank of the River Marañon, north of Peru, above 3000 m.

10. Huanuco: located south of Huanuco, central Peru throughout Cuzco and Marcapata to Limabani, near the border with Bolivia, on the eastern slope of the Peruvian Andes, between 2900 and 4000 m.

11. Yungas: located on the Yungas, north of La Paz, in northern Bolivia, between 3400 and 3900 m.

12. Cochabamba: located on the Yungas, in the surroundings of Cochabamba, southeast of La Paz, between 1600 and 3100 m.

2.1.3.1 Morphometric variation

Pterophanes cyanopterus shows no morphometric sexual dimorphism, males and females being of approximately the same size. Significant differences between pools were only found in the wing-length (Tab. 2.13.1, Fig. 2.13.3-4), specimens from the pools Libertad and

Table 2.13.1. Descriptive statistics of *Pterophanes cyanopterus* morphometric parameters. The pools are ordered geographically from north to south.

Morphometric parameters	Pools	Bogota	Tolima	Cauca	Nariño	Pichincha	Papallacta	Santo Domingo	Huancabamba	Libertad	Huanuco	Yungas	Cochabamba
bill-length (mm)	males												
	mean	36.4	38.1	37.0	36.4	36.1	36.2	36.1	35.6	36.1	37.0	36.4	36.8
	±S.D.	-	-	0.86	1.06	1.02	1.06	0.42	0.70	1.38	0.77	2.36	1.10
	Max.	-	-	38.2	37.9	38.4	37.4	36.4	36.3	37.7	38.2	38.1	39.2
	Min.	-	-	36.4	35.0	34.5	35.4	35.8	34.9	35.3	35.7	33.1	35.7
	N	1	4	4	5	16	16	2	3	3	14	4	8
	females												
	mean	37.3	35.8	36.8	-	36.6	36.1	36.0	36.6	37.3	36.7	35.4	36.9
	±S.D.	-	-	-	-	1.20	-	-	-	0.26	1.40	1.15	1.06
	Max.	-	-	-	-	38.0	-	-	-	37.5	39.0	36.6	38.0
	Min.	-	-	-	-	34.7	-	-	-	37.0	35.7	34.3	35.6
	N	1	1	1	-	10	1	1	1	3	5	3	4
wing-length (mm)	males												
	mean	92.8	96.8	97.6	100.8	103.2	107.0	101.1	103.2	106.1	106.2	105.1	105.2
	±S.D.	-	4.56	8.62	5.28	5.58	1.96	7.28	4.82	-	6.91	8.48	6.74
	Max.	-	100.7	104.4	106.5	110.5	108.2	105.7	106.2	-	114.6	111.9	114.4
	Min.	-	91.8	87.9	92.3	92.1	104.7	92.7	97.7	-	96.0	94.7	96.36
	N	1	3	3	5	16	3	3	3	1	15	5	10
	females												
	mean	92.0	97.8	98.7	-	100.5	93.2	106.1	96.8	109.8	110.0	100.4	103.8
	±S.D.	-	-	-	-	5.59	-	-	-	0.49	2.35	6.32	5.33
	Max.	-	-	-	-	110.4	-	-	-	110.1	112.5	106.4	109.9
	Min.	-	-	-	-	94.1	-	-	-	109.4	106.5	93.8	99.3
	N	1	1	1	-	10	1	1	1	2	5	3	5

Huanuco (9 and 10) having on average the longest wings ($p<0.05$, males: 106.1-106.2 mm; females: 109.8-110.0 mm) and those from northern and central Colombia (from Bogota to Cauca, pools 1-3) the shortest wings ($p<0.05$, males: 92.8-97.6 mm; females: 92.0-98.7 mm).

2.1.3.2 Plumage variation

The source of variation in plumage coloration is limited practically to the amount of blue on the male remiges. In the males from the north Colombian pool (Tolima, 1), head and upperparts are Dark Green 162A; upper tail-coverts greenish Turquoise Green 64. The chin and throat are dark bluish Dark Green 162, with Cinnamon 39 borders; underparts like the chin and throat, without cinnamon borders; under tail-coverts Turquoise Blue 65.

Table 2.13.1 (Continued). Descriptive statistics of the morphometric parameters in *Pterophanes cyanopterus*. The pools are ordered from north to south.

Morphometric parameters	Pools	Bogota	Tolima	Cauca	Nariño	Pichincha	Papallacta	Santo Domingo	Huancabamba	Libertad	Huanuco	Yungas	Cochabamba
tail-length (mm)	males mean	63.3	64.6	66.6	65.7	66.8	66.7	64.6	68.8	67.1	69.5	68.7	68.4
	±S.D.	-	5.76	3.06	3.56	3.37	2.76	3.78	1.90	3.36	5.00	3.18	4.28
	Max.	-	68.6	68.7	70.4	71.7	68.8	67.3	70.2	70.3	76.2	72.0	73.5
	Min.	-	58.0	62.2	61.1	60.6	63.6	60.3	67.5	63.6	60.5	64.9	62.9
	N	1	3	4	5	16	3	3	2	3	15	5	8
	females mean	-	66.2	69.8	-	64.0 5.71 72.0	61.4	67.7	62.8	74.7	71.6 1.10 72.5	66.4 3.62 68.8	68.5 5.05 73.4
	±S.D.	-	-	-	-	-	-	-	-	-	-	-	-
	Max.	-	-	-	-	54.6	-	-	-	-	69.8	62.2	62.2
	Min.	-	-	-	-	-	-	-	-	-	85	23	25
	N	-	1	1	-	9	1	1	1	1			
tail fork-depth (mm)	males mean	10.9	13.6	15.6	15.9	16.8	15.1	12.4	15.4	14.9	17.4	17.1	18.2
	±S.D.	-	2.15	6.12	4.32	5.40	2.40	3.32	3.25	6.46	5.98	3.96	4.61
	Max.	-	15.8	21.0	22.6	22.6	17.6	16.2	17.7	22.2	24.5	20.6	24.2
	Min.	-	11.5	8.93	10.55	4.916	12.83	10.13	13.12	9.93	7.712	12.83	10.17
	N	1	3	3	5		3	3	2	3			
	females mean	-	14.1	22.1	-	13.7 6.54 23.1	5.4	14.3	-	20.2	18.9 2.48 22.4	14.2 3.00 16.5	18.3 5.88 23.6
	±S.D.	-	-	-	-		-	-	-	-			
	Max.	-	-	-	-		-	-	-	-	16.5	10.8	11.5
	Min.	-	-	-	-	3.59	-	-	-	-	55	83	55
	N	-	1	1	-		1	1	-	1			

The tail feathers are bluish Leaf Green 146; wing-coverts Ultramarine 270; remiges dark Raw Umber 223. The females are similar to the males, with the head more brownish and

underparts Tawny 38 with sides of chest and belly yellowish Parrot Green 160. The tail feathers like males, with the outermost feather having white border.

Skins from Bogota (pool 1) exhibit a very similar coloration to that observed for Tolima (pool 2) specimens, except for the more yellowish hue on the upperparts and the larger amount of blue on the wings, occupying more than two thirds of the rectrix length.

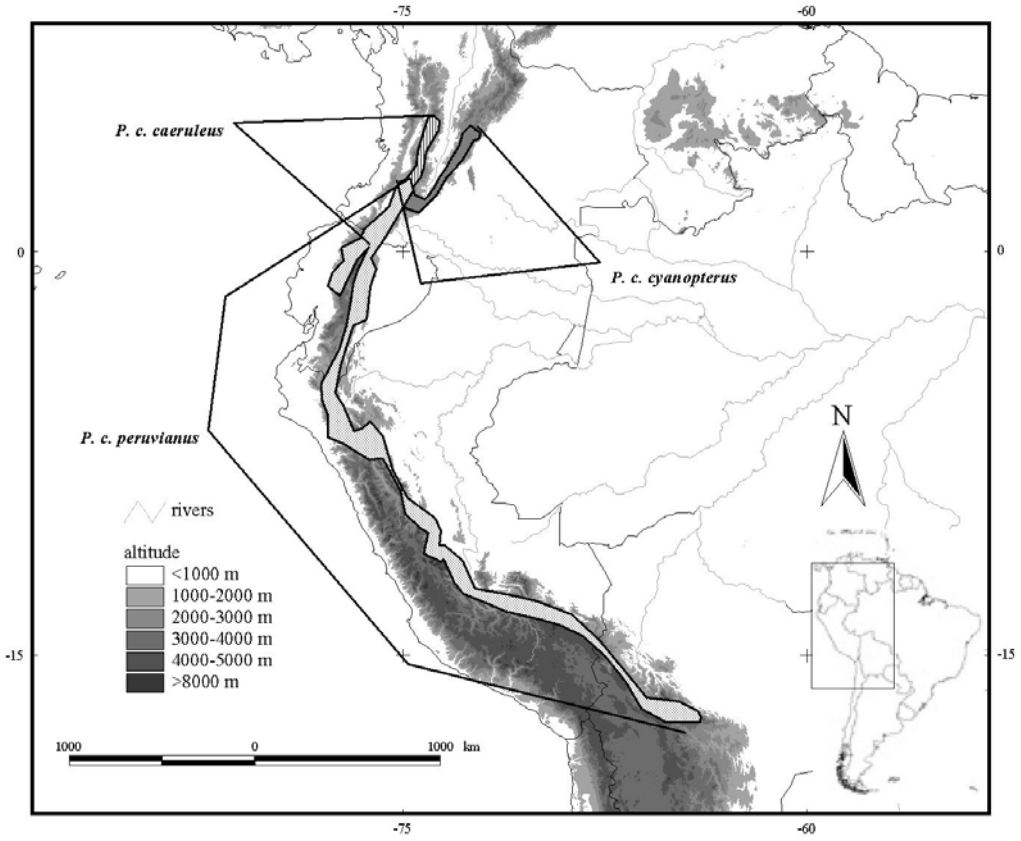


Figure 2.13.2. Geographic distribution of *P. cyanopterus*. The subspecies ranges are represented by filled polygons. Note the contact zone between the three subspecies in southwestern Colombia.

The other differentiated group is formed by the pools from Pichincha to Cochabamba (5-12). The males have head and upperparts Dark Green 162A shadowed black, less dark and more bluish on the lower back; upper tail-coverts turquoise Dark Green 162A. The chin, throat and underparts are very bluish dark Spectrum Green 62, with no cinnamon; under tail-coverts Turquoise Blue 65. The tail feathers are bluish Leaf Green 146; wing-coverts Ultramarine 270 and remiges intense Ultramarine 270, mixed with Spectrum Violet 72, tipped Raw Umber 223. The females are similar to those from the north Colombian pools.

The specimens from the pools located between southern Colombia and northern Ecuador (Cauca and Nariño, 3 and 4) presented a mixture of characteristics that differed from the two

groups described above. Males have the overall coloration pattern observed in the southern pool group (5-12), with the following differences: specimens from Cauca (pool 3) show a reduction in the amount of blue on the underparts and on the remiges, being restricted to the base of the secondaries and to the outermost primaries, but to a greater extent than in the northern Colombian group (pools 1 and 2); specimens from Nariño show more bluish underparts and the blue on the wings is more extensive on the remiges, less so than in the southern pool group. No differences could be observed in females.

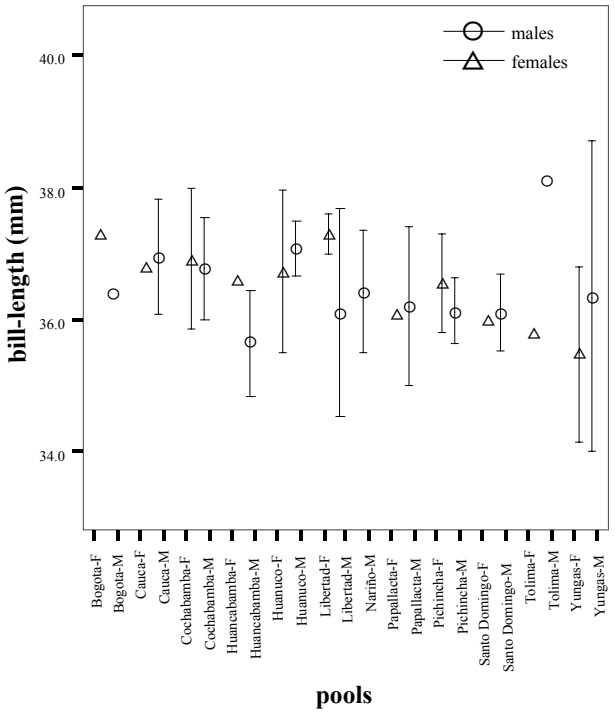
2.1.4 Discussion

The population represented by the Bogota pool corresponds with the nominate race, *Pterophanes c. cyanopterus* (Fraser, 1840), characterised by the more bluish tonalities overall and specially the greater amount of blue on the remiges (Fig. 2.13.2).

The Tolima pool morphologically represents the race *P. c. caeruleus* (Zimmer, 1951), being very similar to the nominate form, but differing in the greater amount of blue on the bodyparts and the reduction of the blue coloration of the secondaries on the remiges (Fig. 2.13.2).

The pool group from Ecuador to Bolivia (from Pichincha to Cochabamba, 5-12) represents the subspecies *P. c. peruvianus* (Boucard, 1895), distinguished by the almost completely blue remiges and the darker and more bluish green overall (Fig. 2.13.2).

The region with the pools Cauca and Nariño (3 and 4) is included in the subspecies range given by Zimmer (1951b), corresponding taxonomically to the race *P. c. caeruleus* (Zimmer, 1951), but the mixture of characters observed agrees with the remark by Zimmer concerning the resemblance of the north Ecuadorian birds to both *P. c. caeruleus* and *P. c. peruvianus*. This situation indicates the presence of a zone of intergradation between these two races and perhaps also *P. c. cyanopterus*. To verify and confirm the subspecies contact a thorough study of the East Andes south of Bogota is necessary.



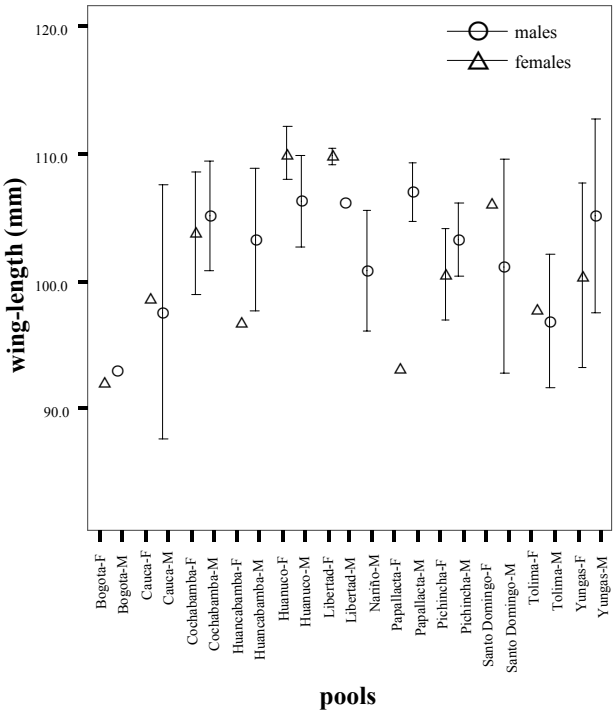


Figure 2.13.3. Geographic variation of the bill- and wing-length in *P. cyanopterus*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the stadard error of the mean. Pools are ordered geographically from north to south.

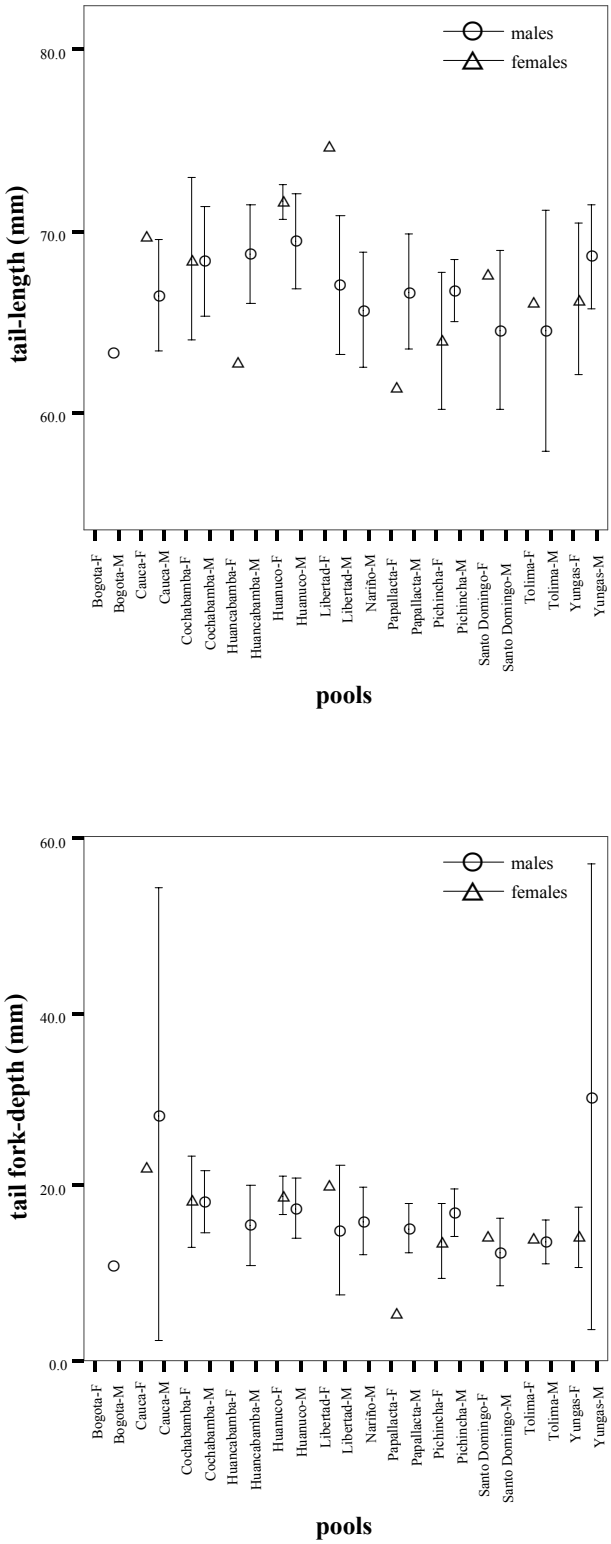


Figure 2.13.4. Geographic variation of the taill-length and tail fork-depth in *P. cyanopterus*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the stadard error of the mean. Pools are ordered geographically from north to south.

3. Genus *Ensifera* Lesson, 1843

Ensifera is a monotypic genus consisting of individuals with an extremely long bill, longer than the body and head and compressed laterally, that inclines upwards at the tip, feathered up to 1 cm, hiding the nostrils. The wings are long and pointed and the tail deeply forked; feet small with tarsi partially feathered. The sexes are different in size and coloration.

3.1 *Ensifera ensifera* (Boissoneau, 1839)

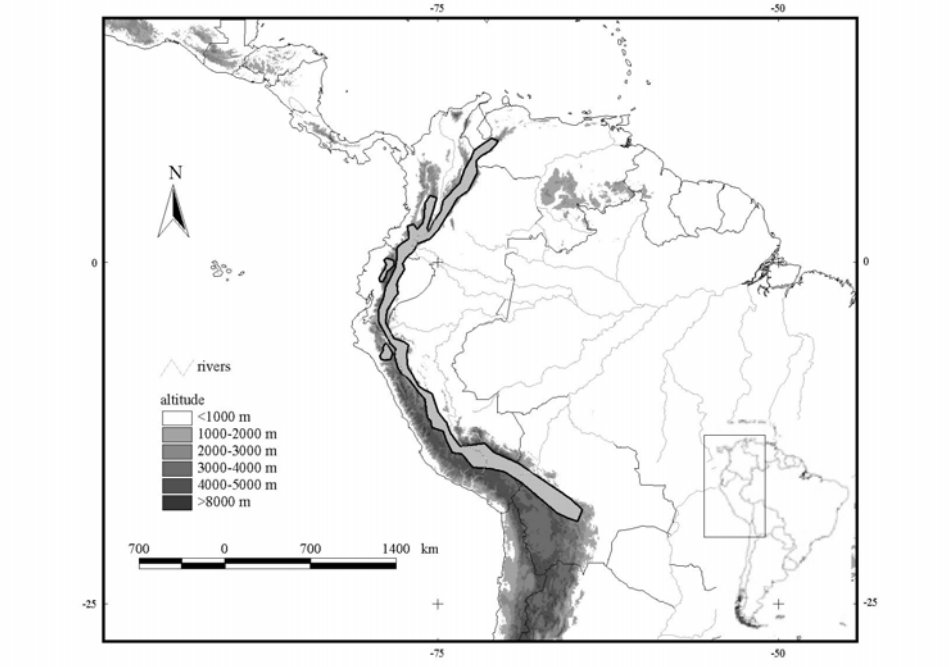


Figure 2.14. Geographic distribution of the genus *Ensifera*. The polygons represent the range of the monotypic species *E. ensifera*.

3.1.1 Taxonomy and Distribution

The range of *Ensifera ensifera* (and subsequently of the genus) extends from the Andes of western Venezuela (Merida) to north-eastern Bolivia, along the eastern slopes of the East, Central and West Andes in Colombia, and the Ecuadorian, Peruvian and north Bolivian Andes (Fjeldså & Krabbe 1990, Hilty & Brown 1986, Schuchmann 1999). The genus *Ensifera* was described by Lesson (1843, cited in Peters 1945).

The description of the *Ensifera* type species by Boissoneau (1839) from a male specimen from Santa Fe de Bogota preceeds the genus description. Boissoneau assigned to the taxon

the name *Ornismya ensifera*. This species only was placed by several authors in the genus *Docimastes* Gould, 1849 using the masculine spelling: *D. ensiferus* (Bonaparte 1850, Gould 1861, Reichenbach 1853).

Heine (1863) differentiated two forms based on body size, one smaller in the north of the range (New Granada) and the larger in the south (Ecuador), and gave the name *Docimastes Schliephackei* to the Ecuadorian form. Later, several authors refused to use this classification, for the difference in size was explained as individual variation, also observed within the Colombian specimens (Berlioz 1936, Elliot 1878, Hartert 1900, Simon 1921, Taczanowski 1874). Some of them preferred the spelling used by Heine (1863): *D. ensifer*. Lowe (1939) described *Docimaster ensiferus cærulescens* based on a male specimen from 'South America' (deposited in the Royal Albert Memorial Museum in Exeter). This form seems to be distinct by its smaller size and blue coloration on the chest.

Chapman (1917), and later Peters (1945), placed these two taxa in the genus *Ensifera* Lesson, 1843 with *Ornismya ensifera* (=*Ensifera ensifera*) as the type species. More recently, Walters (1986) recognised that the two forms for the species agreed with Peters' opinion, but expressed the necessity of collecting more evidence to solve the uncertainty.

Modern revisions have brought more clarity to this problem. Graves (1991) places *E. e. caerulescens* definitively in synonymy with *Ensifera ensifera* (Boissonneau, 1839). The current taxonomy of the genus recognises only one monotypic species (Fjeldså & Krabbe 1990, Schuchmann 1999).

3.1.2 Diagnosis

Members of *Ensifera ensifera* are immediately recognisable by the extremely long bill. The species is dimorphic, slightly so in coloration but more obviously in morphometry. The males are bronzy Greenish-Olive 49 on the head and nape with a white postocular patch; upperparts and upper tail-coverts yellowish Parrot Green 260 fringed glittering Turquoise Green 64. Chin and throat have white feathers with a Greenish-Olive 49 centre giving a very scaly aspect; upper chest Spectrum Green 62; underparts with white feathers centred Yellowish Olive-Green 50 giving scaly aspect; under tail-coverts Yellowish Olive-Green 50 tipped white. The wings-coverts are yellowish Parrot Green 260; remiges Fuscous 21; rectrices Greenish-Olive 49, outermost rectrices bordered white. The females are very similar to the males, with more white and smaller olive centres overall on the underparts.

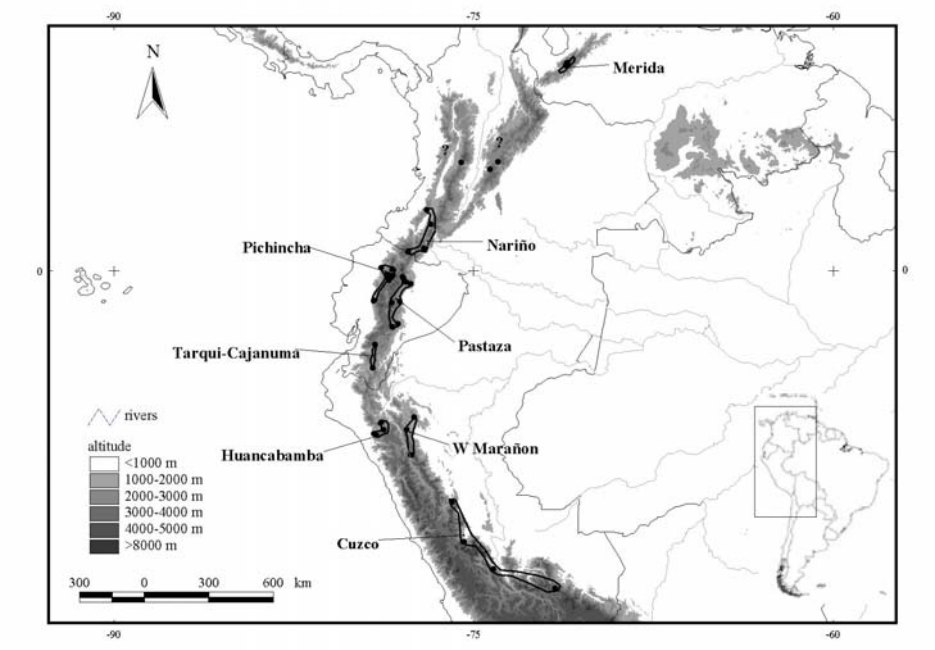


Figure 2.14.1. Geographic distribution of *E. ensifera*. The polygons represent the geographic pools, the dots the localities.

3.1.3 Geographic variation analysis

A total of 89 specimens of *Ensifera ensifera* (55 males and 34 females) was studied. The localities were grouped into eight geographic pools, which are listed from north to south:

1. Merida: located in the surroundings of Merida, in the Venezuelan Andes, between 2500 and 4000 m a.s.l.

2. Nariño: located near Almaguer, on the western bank of the River Cauca, in the border of Colombia and Ecuador, between 3000 and 3400 m.

3. Pichincha: located on the western slopes of Pichincha Volcano, on the western side of the Ecuadorian Andes, between 1500 and 3500 m.

4. Pastaza: between the Rivers Sumaco and Pastaza, near Papallacta, on the eastern slopes of the Ecuadorian Andes, between 1400 and 3300 m.

5. Tarqui-Cajanuma: located in the Loja Region, on the western slopes of the southern Ecuadorian Andes, between 2500 and 2800 m.

6. Huancabamba: located in the surroundings of Cutervo and Chugur, on the eastern bank of the River Marañon, northern Peru, between 2500 and 2800 m.

7. W Marañon: located near Leimabamba, on the western bank of the River Marañon, northern Peru, between 3000 and 3500 m.

8. Cuzco: located from the vicinity of Pozuzo, central Peru, to Paucartambo, near Cuzco, in south-eastern Peru, on the western slopes of the Andes, between 3000 and 4200 m.

3.1.3.1 Morphometric variation

Ensifera ensifera is morphometrically dimorphic, with males having shorter bills but longer wings and longer and more deeply forked tails. Only in the bill-length were significant differences found, specimens from Merida and Pichincha (pools 1 and 3) having the longest bills (males: 103.2-104.1 mm; females: 102.2-112.2 mm) and those from W Marañón and Cuzco (pools 7 and 8) the shortest (males: 78.8-87.1 mm; females 93.2-97.6 mm). No other significant difference was found (Tab. 2.14.1, Fig. 2.14.3-4).

3.1.3.2 Plumage coloration

No relevant geographic variation was found between the specimens from the pools. Within the males, two forms were found that were present in all populations (one of them with relatively higher frequency in specimens from Merida, pool 1). The forms differ in the proportion of white on the chin and throat, and the more bronze coloration of the head compared with the upperparts. The males have a very bronzy Greenish-Olive 49 (form 1) or yellowish Parrot Green 260 (form 2) head; nape Spectrum Green 62; upperparts yellowish Parrot Green 260; upper tail-coverts Parrot Green 260 with turquoise sheen. The chin and throat with variable pattern, with feathers with a small Parrot Green 260 centre and one wide Dark Brownish Olive 129 band with a wide white border (form 1), or very thin, almost absent white tips (form 2); chest bluish Spectrum Green 62, remaining underparts bluish-yellowish Parrot Green 260 mottled Dark Brownish Olive 129; under tail-coverts yellowish Parrot Green 260 bordered white. The tail feathers are golden Olive-Green 46, with no tipping; wing-coverts bluish Parrot Green 260; remiges Raw Umber 223, with no pale outer border. The females are similar to males, presenting a more accentuated scaly pattern on chin and throat, with a higher predominance of white; the underparts have a scaly aspect, very mottled, with white in the centre and more Spectrum Green 62 at the sides. The rectrices are brownish Olive-Green 50, with the outer rectrix border white.

Table 2.14.1. Descriptive statistics of the morphometric parameters in *E. ensifera*. The pools are ordered geographically from north to south.

Mophometric parameters	Pools	Merida	Nariño	Pichincha	Pastaza	Tarqui-Cajanuma	Huancabamba	W Marañon	Cuzco
bill-length (mm)	males								
	mean	103.2	90.3	104.1	99.2	106.8	97.0	78.8	87.1
	±S.D.	2.23	7.35	3.70	6.39	6.58	2.67	-	5.64
	Max.	106.4	95.5	110.0	109.3	111.4	98.7	-	92.6
	Min.	99.9	85.1	97.3	88.3	102.1	93.0	-	80.8
	N	10	2	12	16	2	4	1	4
	females								
	mean	112.2	95.2	102.2	107.1	110.6	102.8	93.2	97.6
	±S.D.	2.83	7.42	8.72	6.41	-	2.58	-	-
	Max.	114.9	103.8	120.0	117.7	-	105.3	-	-
	Min.	107.6	90.9	94.7	100.2	-	99.2	-	-
	N	7	3	6	8	1	4	1	1
wing-length (mm)	males								
	mean	76.7	78.4	77.2	77.9	79.1	77.8	75.4	77.0
	±S.D.	1.19	3.46	1.34	2.51	4.24	1.70	-	3.02
	Max.	78.3	80.8	78.8	82.1	82.1	80.1	-	80.7
	Min.	74.8	75.9	75.0	74.2	76.1	75.8	-	74.0
	N	11	2	12	17	2	5	1	4
	females								
	mean	75.4	74.2	77.3	75.6	81.6	76.4	75.6	75.5
	±S.D.	3.32	1.75	1.40	3.46	-	0.58	0.84	0.28
	Max.	78.2	76.8	78.7	78.9	-	77.3	76.2	75.7
	Min.	68.9	73.1	75.5	69.6	-	76.1	75.0	75.3
	N	7	4	6	8	1	4	2	2

3.1.1 Discussion

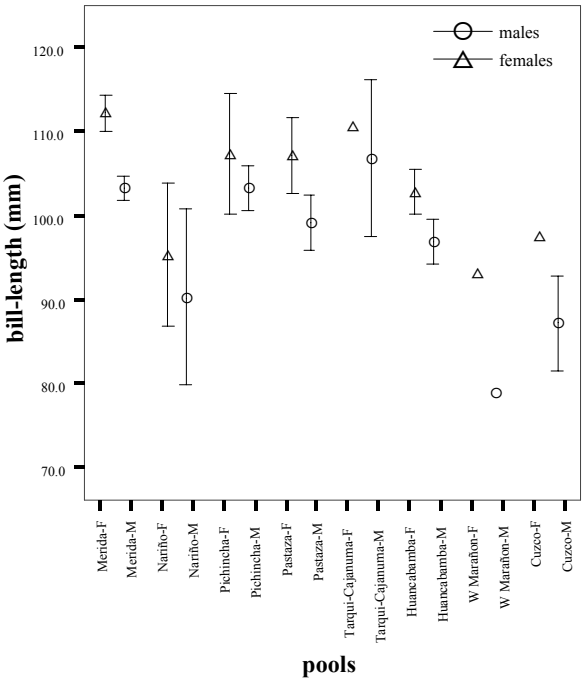
The only actually observed geographic variation was detected in the bill-length, the Peruvian populations being distinct because of their shorter bills, but due to the lack of material for this region this condition could not be studied in the populations south of Peru, e.g., in north-eastern Bolivia (Bond & Meyer de Schauensee 1943, Remsen & Traylor 1989) to Santa Cruz (Fjeldså & Krabbe 1990).

The Merida Andean range is apparently isolated from the central Colombian population by the Tama region. This isolation seems to be supported by the lack of material from the area (despite the intensive collecting carried out in the Merida-Tama area, no known specimen or observation for this area has been reported; Sánchez Osés 1995). The higher frequency of one

of the forms in Merida specimens is an indicator of an incipient differentiation process occurring in this population, which would eventually establish a distinct race.

Table 2.14.1. (Continued) Descriptive statistics of the morphometric parameters in *E. ensifera*. The pools are ordered geographically from north to south.

Mophometric parameters	Pools	Merida	Nariño	Pichincha	Pastaza	Tarqui-Cajanuma	Huancabamba	W Marañon	Cuzco
tail-length (mm)	males								
	mean	55.1	63.2	59.2	59.2	57.8	59.0	57.9	77.0
	±S.D.	4.70	0.64	4.79	5.30	9.68	5.20	-	3.02
	Max.	60.8	63.6	65.7	65.7	64.6	65.5	-	80.7
	Min.	46.2	62.7	49.4	49.0	50.9	54.7	-	74.0
	N	11	2	12	17	2	4	1	4
	females								
	mean	50.2	52.0	51.4	53.4	61.2	49.7	51.0	48.1
	±S.D.	3.80	5.90	2.94	5.06	-	3.18	3.88	1.41
	Max.	56.7	58.3	55.0	62.3	-	53.7	53.8	47.1
	Min.	46.8	46.6	48.5	46.8	-	47.1	48.3	49.1
	N	7	3	6	8	1	4	2	2
tail fork-depth (mm)	males								
	mean	19.4	30.5	23.1	24.4	22.2	23.6	25.3	23.7
	±S.D.	5.69	0.70	6.26	6.86	10.54	7.33	-	4.89
	Max.	26.7	31.0	31.5	32.5	29.7	31.9	-	29.8
	Min.	9.2	30.0	9.0	9.0	14.8	16.8	-	18.2
	N	11	2	12	17	2	4	1	4
	females								
	mean	13.4	17.2	14.4	16.4	26.6	12.4	16.4	11.4
	±S.D.	4.62	8.54	4.04	6.28	-	4.06	-	0.84
	Max.	21.8	26.5	19.4	28.6	-	17.1	-	12.0
	Min.	8.4	9.7	10.1	8.3	-	8.9	-	10.8
	N	7	3	6	8	1	4	1	2



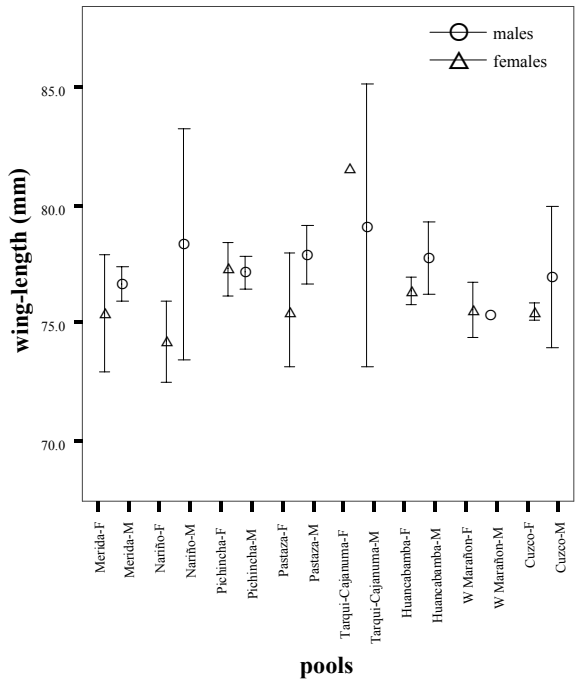
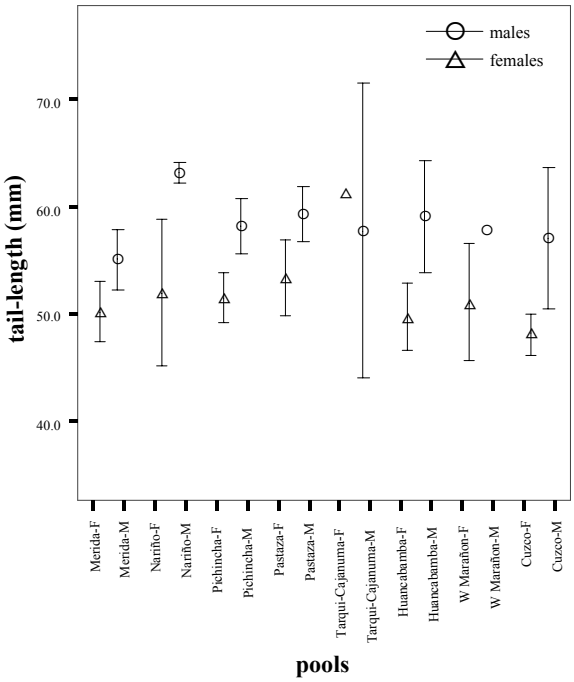


Figure 2.14.3. Geographic variation of the bill- and wing-length in *E. ensifera*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. The pools are ordered geographically from north to south.



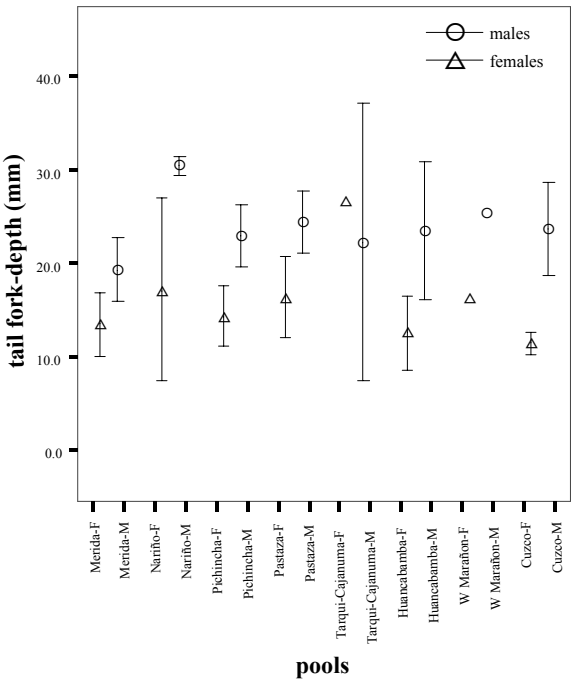


Figure 2.14.4. Geographic variation of the bill- and wing-length in *E. ensifera*. The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical lines the standard error of the mean. The pools are ordered geographically from north to south.

4. Genus *Patagona* Gray, 1840

The genus *Patagona* includes only one species, *P. gigas*, diagnosable by its very large size and the long, straight and stout bill, longer than the head and slightly feathered. The wings are very long, almost reaching the end of the tail; tail long and forked. The feet are large and stout, the tarsi feathered to the toes. The sexes are alike (Elliot 1878, Boucard 1895, Hartert 1900).The genus was erected by Gray (1840).

4.1 *Patagona gigas* (Viellot, 1834)

4.1.1 Taxonomy and Distribution

Patagona gigas is distributed from southern Colombia and extreme northern Ecuador to central-western Argentina (Mendoza), where the southern population's winter quarters are located. Two subspecies are currently recognised: *P. g. peruviana*, in the north, hypothetically from Nariño, in the south-eastern Andes of Colombia (Hilty & Brown 1986) and extreme northern Ecuador to northern Chile and north-western Argentina (Catamarca and Tucumán); *P. g. gigas* occurs in central and southern Chile and in central-western Argentina, migrating to north-west Argentina in winter (Fjeldså & Krabbe 1990, Schuchmann 1999). No migration has been reported for *P. g. peruviana*, impliying a probably contact and intergradation between the subspecies.

The type species of the genus *Patagona* was described by Vieillot in 1824 as *Trochilus gigas*, giving Brazil as the type locality, which later was corrected to 'Chile' by Lesson (1832) and additionally renamed *Ornismya tristis*. Gray (1840) described the genus *Patagona*, giving *P. gigas* (Vieillot, 1824) as the type species and extending its distributional range to Argentina, this name being adopted by several authors as the valid one for the taxon (Reichenbach 1853, Gould 1861, Elliot 1878, Taczanowski 1884). Boucard (1895) proposed the names *P. peruviana* and *P. boliviana* for two new species from Peru and Bolivia respectively, which were later merged into *P. gigas* (Hartert 1900, Simon 1921).

Hellmayr (1932), and later Peters (1945) and Zimmer (1952), recognised the validity of *P. g. peruvianus* Boucard 1895 as the northernmost subspecies, these two subspecies being the currently valid taxa for *P. gigas*.

4.1.2 Diagnosis

Patagona gigas is easily recognisable by both its large size and overall dull coloration in both sexes, showing very bluish Parrot Green 160 on the head, bordered brownish white, more accentuated near the bill; eye-ring and postocular spot white; upperparts yellowish Parrot Green 160; feathers on the lower back with conspicuously wide white borders; upper tail-coverts very bluish Olive-Green 47. Feathers on the chin and throat have a dark Grayish Olive 43 coloration bordered Cinnamon 39, giving a scaly aspect; underparts like throat, with less Cinnamon 39; belly Cinnamon 39 mottled white; under tail-coverts very white, with a thin brownish line in the feather centres. The rectrices are bluish Olive-Green 47, slightly tipped white; outermost rectrix very brownish white tipped Olive-Green 47; wing-coverts like upperparts, remiges Raw Umber 223 slightly tipped white; border of the outermost primary white.

4.1.3 Geographic variation analysis

A total of 496 specimens of *Patagona gigas* (106 males and 98 females) was examined. The localities were grouped into 15 geographic pools and ordered from north to south:

1. Pichincha: located in the surroundings of Pichincha Volcano, on the western slopes of the Ecuadorian Andes, between 1900 and 3300 m a.s.l.

2. Cutervo: located between Huancabamba and Cochabamba, in the north Peruvian Andes, between 1600 and 2600 m.

3. Cajamarca: located near Cajamarca, southern Peru and in northern Bolivia, between 1980 and 3650 m.

4. Ancash: located in Yungay, near Huascarán National Park, on the western slopes of the north-east Peruvian Andes, between 2400 and 3200 m.

5. Huanuco: located in La Union, near the headwaters of the River Marañon, central Peru, between 3100 and 3200 m.

6. Junin: located from the vicinity of Paucartambo to Tarma, in the central Peruvian Andes, between 3000 and 4200 m.

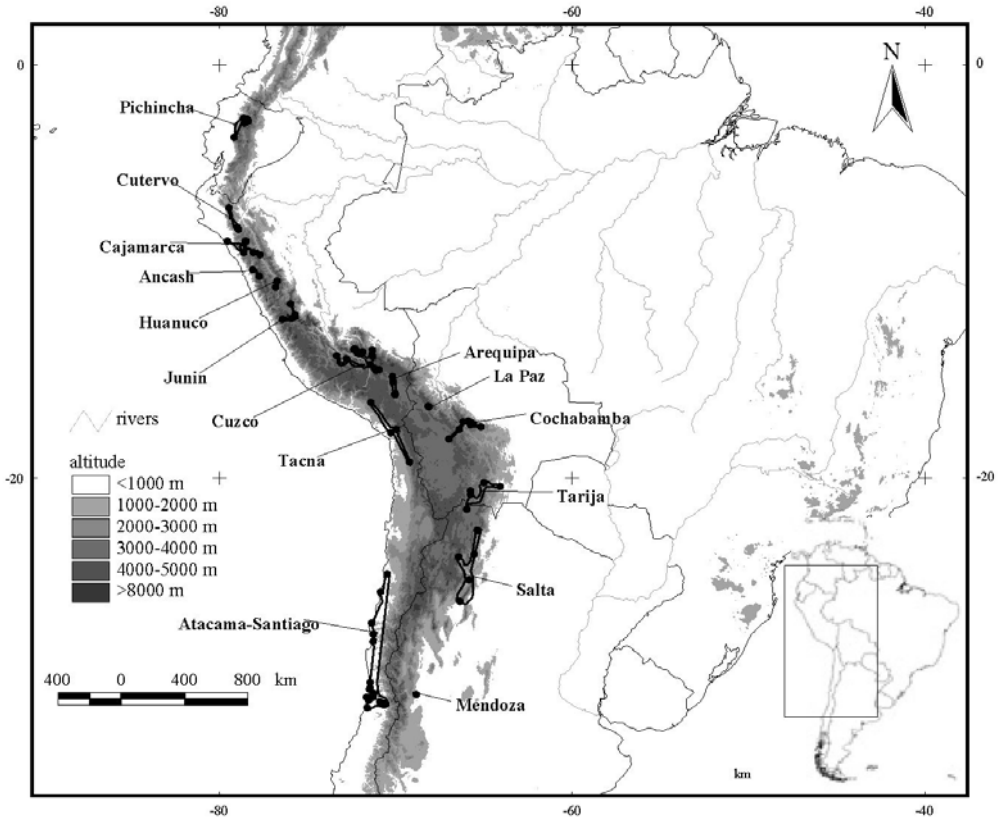


Figure 2.15.1. Geographic distribution of *Patagona gigas*. The polygons represent the geographic pools, the dots the localities.

7. Cuzco: located from Cuzco to Tinta, north of Lake Titicaca, in south Peru, between 2100 and 4300 m.

8. Arequipa: in the surroundings of Arequipa, in southern Peru, at 2340 m.

9. La Paz: located in the vicinity of La Paz, north of Bolivia, at 3600 m.

10. Cochabamba: located from Cochabamba to Poopó, in north-western Bolivia, between 2300 and 3700 m.

11. Tacna: located from El Misti Volcano, in northern Peru to the Volcan Isluga National Park, in northern Chile, on the western slope of the Andes, between 3000 and 4600 m.

12. Tarija: located from the surroundings of Tarija, south-eastern Bolivia to northern Argentina, near Lago de los Pozuelos, between 2500 and 3600 m.

13. Salta: located north-east of Nevado de Chani south to Nevado del Aconguija, northern Argentina, between 1000 and 4000 m.

14. Atacama-Santiago: located along the Coast of Chile, from the vicinity of Chañaral to Villa del Mar, between 0 to 1000 m.

15. Mendoza: located in Mendoza, in central-western Argentina, at 964 m.

Table 2.15.1. Descriptive statistics of the morphometric parameters in *P. gigas*. The pools are ordered geographically from north to south.

Morphometric Parameters	pools	**Pichincha**	**Cutervo**	**Cajamarca**	**Ancash**	**Huanuco**	**Junin**	**Alto Marañon**	**Arequipa**	**La Paz**	**Cochabamba**	**Tacna**	**Tarija**	**Salta**	**Atacama-Santiago**	**Mendoza**
bill-length (mm)	Mean	41.8	42.7	45.2	44.9	44.5	43.8	42.3	43.6	43.9	43.3	44.5	43.7	43.3	39.5	40.3
	±S.D.	1.19	1.99	1.89	1.38	0.99	1.83	1.25	4.72	0.88	2.14	2.57	2.89	2.29	0.99	0.99
	Max.	44.3	45.5	49.6	46.9	45.2	45.7	45.7	46.7	45.3	47.4	47.4	47	47	41.9	41
	Min.	39.7	40.1	42.9	42.5	43.8	38.2	40.5	38.2	42.3	37.8	40.6	38.3	40.2	37.2	39.2
	N	27	8	11	10	2	15	30	3	10	20	7	9	9	25	3
wing-length (mm)	Mean	123.0	121.7	129.4	132.9	130.6	127.8	128.1	127.2	132.7	129.8	129.1	124.1	127.3	123.8	117.4
	±S.D.	5.26	8.38	4.22	2.76	4.31	5.18	5.89	2.37	5.80	6.04	5.63	7.02	7.64	5.10	6.22
	Max.	131.4	134.1	136.6	137	133.6	136.7	137.6	129.9	141	139.5	136.7	134.9	138.8	133.3	124.2
	Min.	112.9	106.6	124.2	127.3	127.5	118.5	117.5	125.7	122.8	116.5	121.2	114	118	113.2	112
	N	27	7	13	10	2	17	32	3	10	23	6	9	9	28	3
tail-length (mm)	Mean	76.7	78.9	82.5	83.3	84.5	80.3	80.0	76.0	83.9	80.3	82.0	80.0	79.1	76.6	74.5
	±S.D.	3.19	3.13	3.20	3.30	4.53	2.25	2.95	5.69	3.57	4.82	2.83	5.37	3.43	3.18	2.08
	Max.	81.9	84.6	88.9	87.8	87.7	85.9	84.8	80.8	90.6	87.4	86.5	91.3	83.8	82	76.9
	Min.	70	74.3	77.1	78.6	81.3	76.8	71.8	69.7	78.2	70.3	79.4	73.3	74	69.7	73.3
	N	27	8	12	10	2	16	33	3	10	18	7	9	9	28	3
tail fork-depth (mm)	Mean	11.3	16.1	15.4	16.4	15.4	13.0	13.1	12.9	20.5	16.0	18.6	20.2	17.2	19.0	15.1
	±S.D.	3.84	4.13	4.25	1.85	1.63	3.23	4.12	2.69	4.91	5.10	4.04	7.98	3.42	2.93	3.24
	Max.	17.8	23	19.7	19.3	16.5	20.8	20.7	14.5	28.3	22.2	22.9	37.7	23.5	25.6	17.2
	Min.	2.8	11.7	7.9	14.3	14.2	8.9	4.1	9.8	15.7	4.1	11.4	13.8	12.9	13.6	11.4
	N	25	7	7	10	2	15	28	3	6	17	7	7	9	26	3

4.1.3.1 Morphometric variation

The statistic analysis showed that in *Patagona gigas* there is no morphometric dimorphism. For this reason, the comparison between the pools was done with both sexes added together (same procedure as in Ortiz-Crespo 1974). Significant differences were found in morphometric parameters ($p<0.05$, Tab. 2.15.1, Fig. 2.15.3-4), the specimens from Cajamarca to Tarija (pools 3 to 11) being on average larger. The longest bills were found in specimens from Cajamarca to Junin (pools 3-6, 45.2-43.8 mm) and the shortest in Atacama-Santiago and Mendoza (pools 14 and 15, 39.5-40.3 mm). The specimens from the pools at the extremes of the range had shorter wings and tails: from Pichincha and Cutervo in the north (pools 1 and 2, wing-length: 121.7-123.0 mm; tail-length: 76.7-78.9 mm) and from Tarija to Medoza in the

south (pools 12-15, wing-length: 117.4-127.3 mm; tail-length: 74.5-80.0 mm) compared with the average values of the central pools (wing-length: 127.8-132.9 mm; tail-length: 80.0-84.5 mm). In contrast, the specimens from Pichincha (pool 1) and from Junin to Arequipa (pools 6-8) showed the least deeply forked tails (11.3-13.1 mm).

4.1.3.2 Plumage variation

Two distinguishable forms were found within the specimens examined, one in individuals from Pichincha to Arequipa (pools 1 to 8), with the head bluish Brownish-Olive 29 with bordered brownish white; eye-ring and postocular spot white; nape and upper back bluish Olive-Green 46; lower back Olive-Green 46 bordered white mixed with pale Cinnamon 39; upper tail-coverts bluish Olive-Green 46 with thin white borders. Chin and throat with a very scaly pattern, showing a Fuscous 21 central line with sides pale whitish Cinnamon 39 and white tips; chest scaly greyish Olive-Green 46 mottled white and Cinnamon 39; belly reddish Cinnamon 39 with sides greyish Olive-Green 46 mottled white and Cinnamon 39, darker in specimens from Pichincha; under tail-coverts white with thin Brownish-Olive 29 central line. The tail feathers turquoise Olive-Green 46, two outermost rectrices pale Fuscous 21 with lateral vane or terminal white; wing-coverts bluish Olive-Green 46; remiges Raw Umber 223, slightly tipped white in some specimens. Specimens from Cuzco and Arequipa (pools 7 and 8) are distinct in having a more conspicuous reddish Tawny 38 instead of Cinnamon 39 overall on the underparts.

Specimens from La Paz to Salta (pools 9-10, 11-13, 15), on the eastern slopes of the Andes, and from Tacna and Atacama-Santiago, on the western slope (pools 11 and 14), are distinguishable by the Olive-Green 46 head with Tawny 38 border, the more reddish brownish hue on the lower back and yellowish hue on the upperparts. The pattern on the chin lacks white, the feathers being in the centre greyish Olive-Green 46 with sides and tips Tawny 38, throat alike with broader brown borders; chest greyish Fuscous 21 bordered Tawny 38; belly feathers black, with white and Tawny 38 bands; upper tail-covert grayish Fuscous 21 with distal half white.

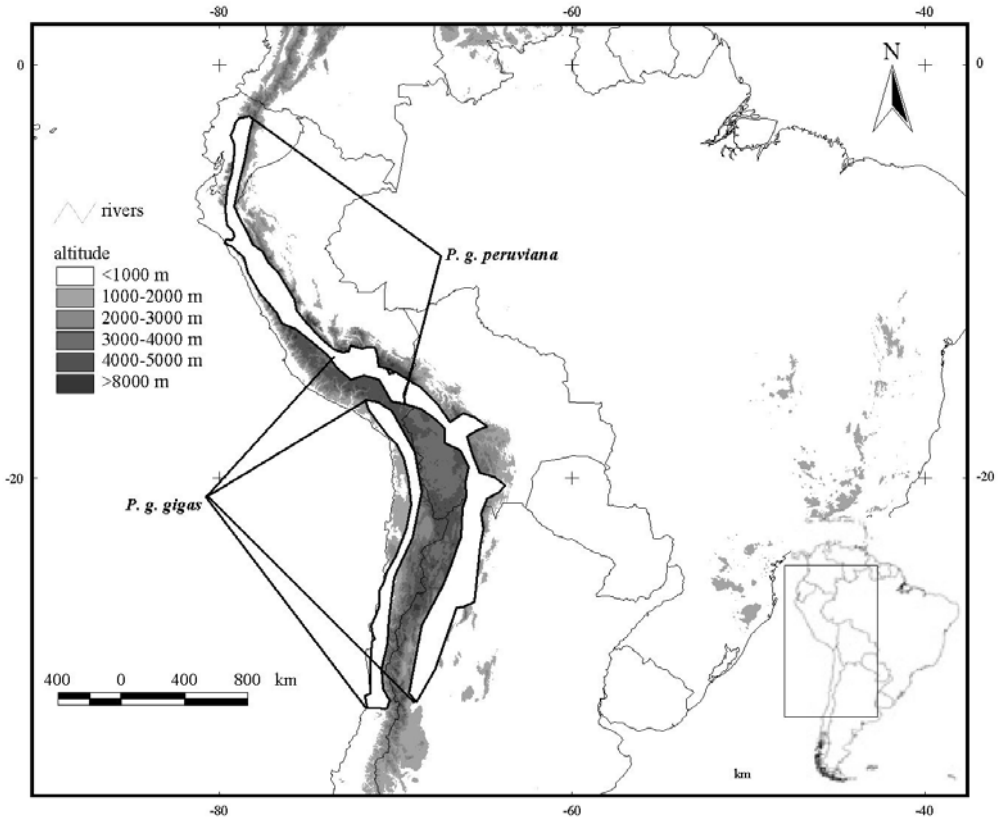


Figure 2.15.2. Geographic distribution of *P. gigas*. The subspecies ranges are represented by filled polygons. Note the contact zone between the two races on the eastern slopes of the Andes of northern Peru.

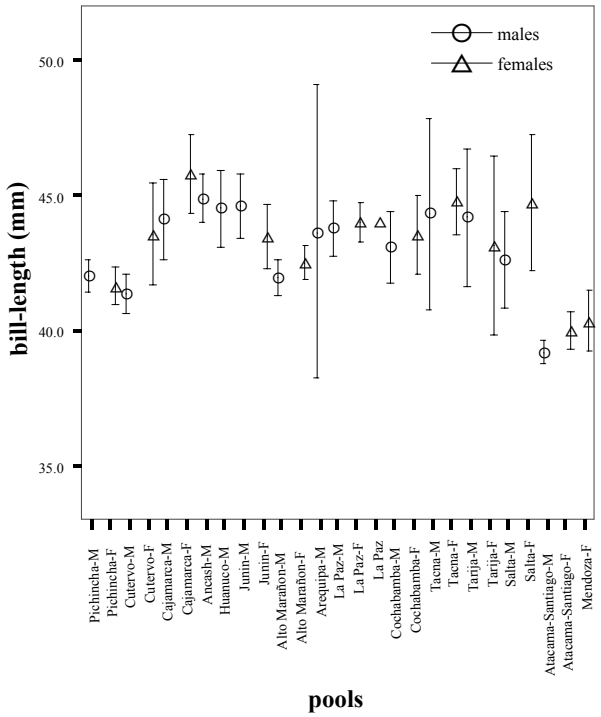
4.1.4 Discussion

The population from Ecuador to south-eastern Peru (pools Pichincha to Arequipa, excluding Tacna, 1-8) represents a distinct unit (Fig. 2.15.2) that corresponds taxonomically with the subspecies *Patagona g. peruviana* (Boucard, 1895), recognisable by the rather yellowish-brownish overall coloration and the presence of white on the chin and throat (this condition is also present in young birds of this race). This subspecies can reach the West Andes of Colombia (Cundinamarca) in the north of its range (after Fjeldså & Barbosa 1983). More recent records north of this region have not been found, except for the recent report on the Colombia-Ecuador border (Volcan Chiles, Woods *et al.* 1998).

The population in northern Bolivia and Chile to Argentina (Fig. 2.15.2) corresponds with the nominate race, *P. g. gigas* (Vieillot, 1824). It is interesting to note that the specimens from Atacama-Santiago (pool 14) were collected from the end of August to the beginning of February (spring and summer in the southern hemisphere) and those from Tacna (pool 11) in

July (winter), these areas being the reported summer and winter quarters, respectively (Fjeldså & Krabbe 1990).

The intensive reddish brown coloration observed on the underparts of specimens from Cuzco and Arequipa (pools 7 and 8), and the absence of geographic barriers separating the two races of *P. gigas*, indicate this area as a possible zone of intergradation between the two subspecies. The populations of *P. g. gigas* seems to be divided into two subpopulations, on both slopes of the Chilean, Bolivian and north Argentinean Andes, by the mountain range of more than 4000 m altitude. The only plausible contact can be made south of Mendoza, where the Andes begin to significantly decrease in altitude (Fig. 2.15.2).



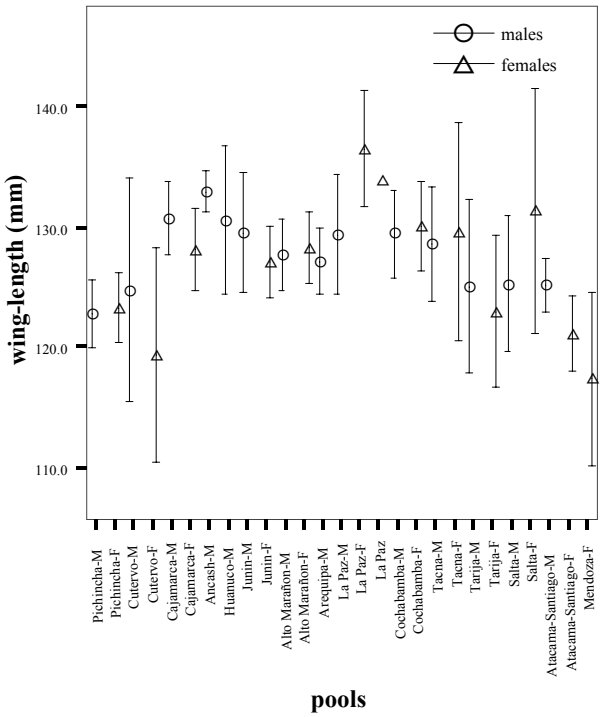


Figure 2.15.3. Geographic variation of the bill- and wing-lengths in *P. gigas.*The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical line the standar error of the mean. The pools are ordered geographically from north to south.

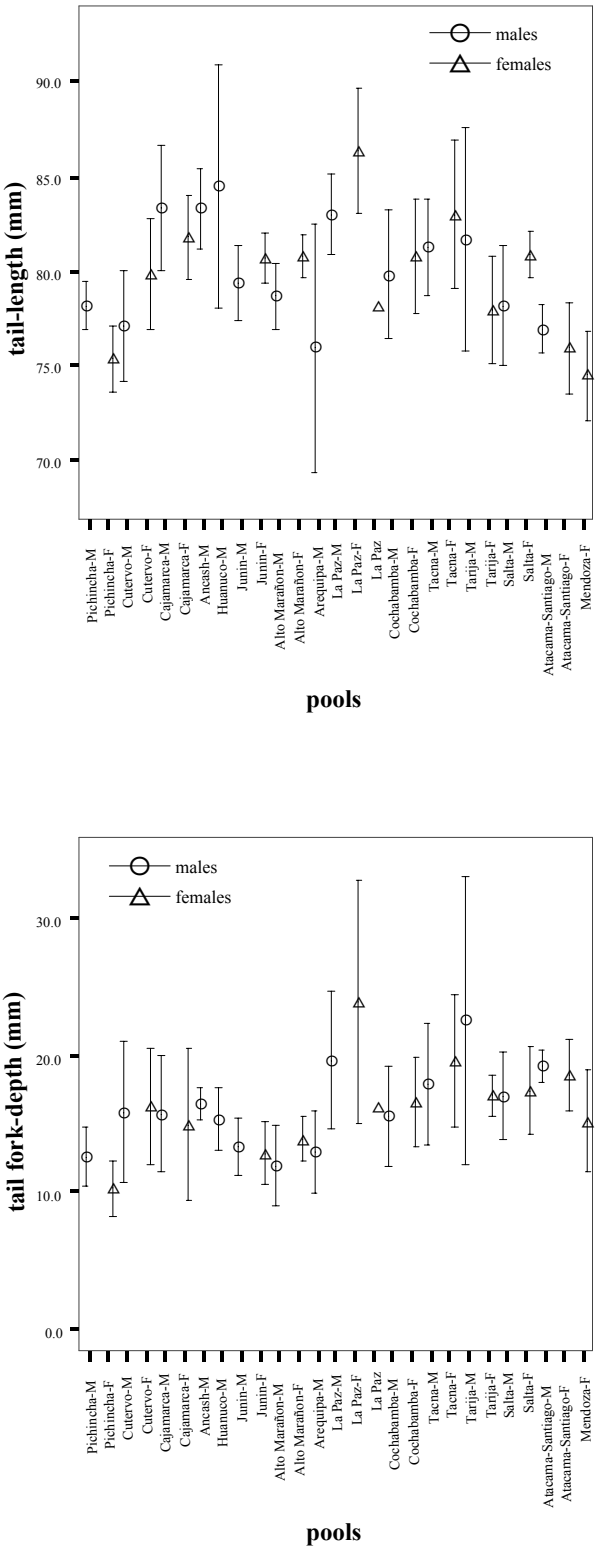


Figure 2.15.4. Geographic variation of the tail-length and the tail fork-depth in *P. gigas*.The circles and triangles represent the arithmetic mean of males and females, respectively; and the vertical line the standar error of the mean. The pools are ordered geographically from north to south.

Phylogenetic Relationships, Biogeography and Taxonomic Conclusions

1. Phylogenetic Relationships

1.1. Results

The maximum parsimony analysis resulted in a single most parsimonious tree of 174.484 weighted steps (CI = 0.604, RI = 0.574, RC = 0.574, HI = 0.396; Fig. 3.1). Of the total 99 characters, 95 were inferred to be parsimony-informative (Tab. 3.1). The clades are described with their respective synapormophies (with CI > 0.500). The character number is indicated and those with CI = 1.000 are marked with an asterisk.

The reconstruction shows the genera *Coeligena*, *Pterophanes*, and *Ensifera* as a well-supported monophyletic group (jackknife value 66%), having *Heliodoxa leadbeateri* as sister group. The status of *Patagona gigas* is not resolved with respect to the general outgroup *Sephanoides sephaniodes*. This clade (node 38→37) presents the apomorphies: 'chest pattern-males' (28) = with discs and/or borders; 'tail pattern-males' (40*) = innermost rectrix different; 'chin hue-females' (69) = no hue; 'throat hue-females' (73) = no hue.

The ingroup that separates the species of the genera *Coeligena*, *Pterophanes*, and *Ensifera* (node 37→36) from *H. leadbeateri* is well-supported (jackknife value 74%), being defined by the following derived characters: 'chest-males' (27) = different from the throat; 'rectrices hue-males' (43) = yellowish; 'belly pattern-females' (80) = mottled with other colour; 'belly main colour-females' (81) = green; 'base of the bill' (98*) = narrow. *Heliodoxa leadbeateri* is defined by the autapomorphies: 'head hue-males' (6) = yellowish; 'nape-males' (7) = green and brown; rectrices main colour-males (42) = black; tail pattern-females (89) = inner rectrix different; 'bill curvature direction' (97) = downwards.

The monophyletic group is divided at the base into two large lineages: one including the species *Coeligena inca*, *C. torquata*, *C. insectivora* and *C. conradii* (node 36→35; jackknife value 63%) with better support than the other that includes the remaining species (node 36→32; jackknife value <50%).

The change 36→35 presents the following synapomorphies: throat main colour-males (24) = white; throat pattern-females (71) = with a central collar; throat extra colour-females (74) = none; tail pattern-females (89) = inner rectrix uniform, outer with bilobed pattern. *C. inca* represents the sister group of the clade formed by node 35→34, with the autapomorphies: 'head colour-males' (5) = black; 'head hue-males' (6) = greenish; 'upper back extra colour-

males' (11) = turquoise; 'lower back extra colour-males' (14*) = turquoise; 'throat main colour-males' (24) = brown; 'crown-females' (47) = with scaly pattern; 'chin main colour-females' (68) = brown; 'chin hue-females' (69) = reddish; 'throat main colour-females' (72) = brown; 'throat hue-females' (73) = reddish; 'belly pattern-females' (80) = with discs; 'belly hue-females' (82) = bluish.

Table 3.1. Matrix of characters employed for the phylogenetic reconstruction. For details see text and appendix.

'H. leadbeateri'	0000000000 0000000020 0001340000 0000000000 0000000000 0000000000 0000000000 0000000000 0000000000 000000000
'C. coeligena'	3100124311 0432331004 1100001101 0102210001 0232000100 2322002310 4211320000 0000211111 2020103142 330001210
'C. phalerata'	1000043203 0040440025 1301521001 0000003001 0352002001 0002000300 0201003142 0143422313 0030212341 030001210
'C. conradii'	3100003202 0010000023 0200541004 0003000320 1211000000 0003100200 0101000050 1003412213 2011000230 210001210
'C. bonapartei'	1220243000 0320200023 1311421004 1044010001 0252030000 1514010100 0000000110 0110022010 0000102110 200121210
'C. eos'	1210233000 0320210125 1311421004 1040001021 2110030100 0504000001 3310230110 0110412103 3020012012 320131210
'C. helianthea'	1200241403 0240140025 1301021004 0003002421 0252000100 1514010001 2300153112 0113411103 2220011040 430001210
'C. torquata'	2300013103 0040042123 1200541001 0002000420 1251000000 0203000200 0100010000 1003412313 2030100230 010001210
'C. prunellei'	3100011221 0120320035 1212541213 1121111211 0142100100 0113111211 1311343302 3201131401 4340112242 131001210
'C. wilsoni'	3100124303 3432330024 1213541203 1102210401 0232000100 2322010311 4211323232 3002111401 2221103140 330001210
'C. lutetiae'	1210243103 0040040123 1311421004 1000010401 0252200010 0000100100 0001021110 0110412213 2010100110 210120110
'C. violifer'	3100013000 0000330020 1301321304 1100201221 2130000100 0100100100 0001320110 2312113203 2020012012 320001210
'C. iris'	0401--1403 3430330120 1311521003 1032001221 2130001112 --12110310 4211320050 0000424313 0430012012 320001210
'C. aurora'	0021--1411 0430330115 1011301003 1032001201 2130001211 --12110300 4200320050 0020112403 0431012012 320001210
'C. insectivora'	2220041402 0010042123 1200541003 0000000420 1221000000 0504000000 0301000050 1003413313 2131001030 110001210
'C. inca'	1000233100 1001000022 1204141004 0003000020 1211002001 0000100100 0001001140 1143013310 2130001030 210001210
Ensifera	3100023000 0000001020 0101331004 1000210011 0212000000 0300100100 0001010000 0000311014 2200100220 310000111
Pterophanes	3100043403 0040042015 0002540004 0003000321 0252020000 2404100000 0301001110 0110322014 0000003000 023001211
Patagonas	3100043000 0003001024 0101030101 1030111412 2201010110 0200100110 0021012231 ?333211110? 0010210220 212211200
S. sephaniodes	0401--3000 0000001004 0100040123 0112310002 0210000000 0000000100 0000000030 0030001010 1300100120 220001200

The clade 35→34 (*C. torquata*,(*C. insectivora*, *C.conradii*)) received good support (jackknife value 74%), exhibiting the synapomorphies: lower back hue-males (13) = bluish; and upper tail-coverts hue-males (16) = no hue. *C. torquata* is defined as the sister group of the clade *C. insectivora* – *C. conradii* (node 34→33; jackknife 49%), this clade presenting the synapomorphy chin hue-females (69) = brownish. *C. insectivora* has the autapomorphies: 'crown hue-males' (3) = yellowish; 'nape-males' (7) = black; 'rectrices hue-males' (43) = greyish; 'head hue-females' (52) = none; 'belly hue-females' (82) = bluish. *C. conradii* is defined by the following derived characters: 'head hue-males' (6) = yellowish; 'upper tail-coverts hue-males' (16) = yellowish.

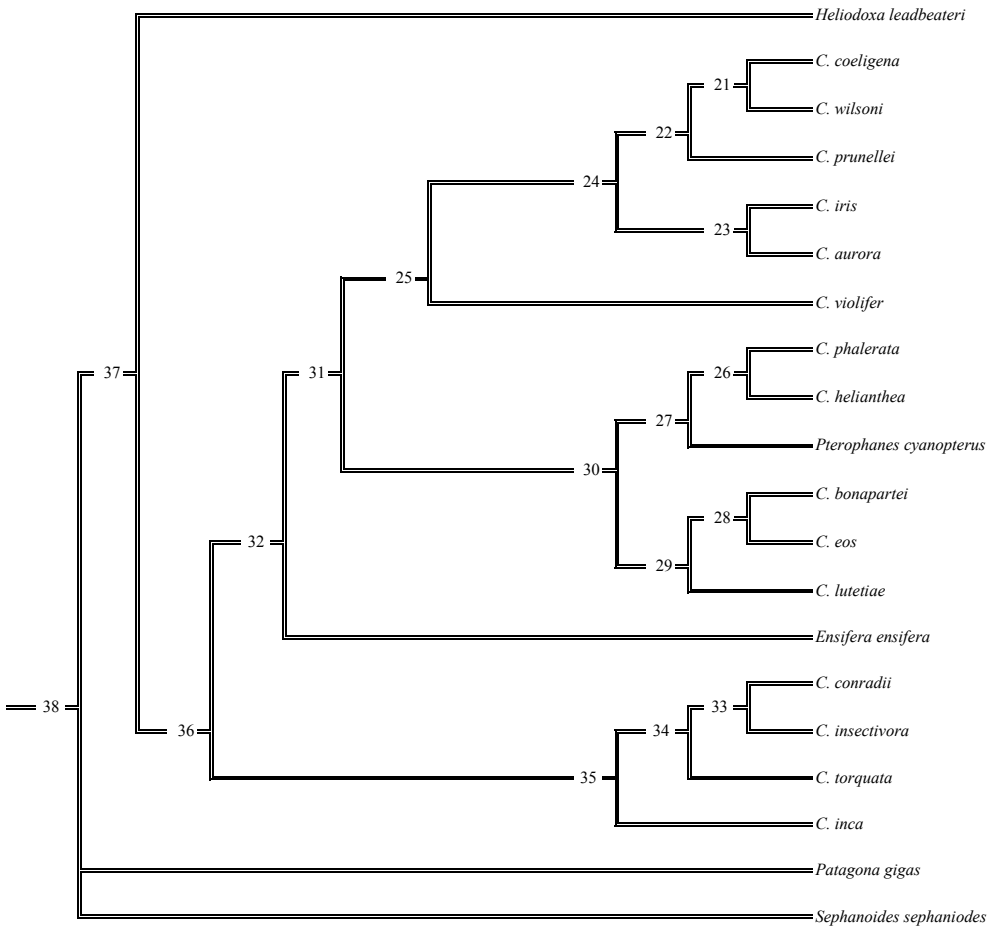


Figure 3.1. Maximum parsimony consensus tree. Numbers represent the node referred to in the text as the numbers in parenthesis.

The autapomorphies corresponding to *C. torquata* are: 'head hue-males' (6) = no hue; 'lower back hue-males' (13) = no hue; 'rectrices hue-males' (43) = no hue; 'head hue-females' (52) = bluish; 'upper tail-coverts hue-females' (66) = bluish.

The second basal clade including the genera *Ensifera*, *Pterophanes*, and the remaining species of *Coeligena* (node 36→32) presents *Ensifera ensifera* as the sister group of the remaining taxa (node 32→31, jackknife value 45%), which later divides into two well-supported lineages. This clade shows the following synapomorphies: 'upper tail-coverts hue-males' (16) = reddish; 'rectrices hue-males' (43) = reddish; 'chin main colour-females' (68) = brown; 'chin hue-females' (69) = brownish; 'throat hue-females' (73) = yellowish; 'tail pattern-females' (89) = with tips or borders. *Ensifera ensifera* exhibits the following autoapomorhies: 'head hue-males' (6) = brownish; 'head hue-females' (52) = reddish; 'upper tail-coverts hue-

females' (66) = bluish; 'belly pattern-females' (80) = medially different; 'belly hue-females' = blackish; 'bill curvature direction' (89) = upwards; 'bill compression' (89) = lateral.

The group formed by the remaining taxa produces two more sub-clades, both receiving good support. One of them (node 31→25) divides into three consecutive groups; the other one (node 31→30, jackknife value 66%) leads to two branches, each including three taxa.

The clade 31→25 is very well-supported (jackknife value 90%), presenting two more internal clades: node 25→24, with *C. violifer* as sister group, 24→23 and 24→22. The synapomorphies characterising this group are: 'head hue-males' (6) = blackish; 'upper tail-coverts colour-males' (15*) = brown; 'under tail-coverts main colour-males' (37) = brown; 'rectrices main colour-males' (42) = brown; 'head hue-females' (52) = blackish; 'upper tail-coverts main colour-females' (65*) = brown; 'upper tail-coverts hue-females' (66) = reddish; 'tail main colour-females' (90) = brown. The clade 25→24 is defined by the following synapomorphies: 'nape-males' (7) = black; 'lower back main colour-males' (12*) = brown; 'lower back hue-males' (13) = reddish; 'nape colour-females' (53) = black; 'lower back main colour-females' (61*) = brown; 'lower back extra colour' (63) = green; 'chin main colour-females' (68) = white; 'chin hue-females' (69) = none; 'throat hue-females' (73) = none. *C. violifer* presents the following autapomorphies: 'chest pattern-males' (28) = with a white band; 'throat pattern-females' (71) = with metallic colour; 'throat main colour-females' (72) = green; 'throat extra colour-females' (74) = violet.

The node 24→23 is well-supported (jackknife value 94%), being formed by the taxa *C. iris* and *C. aurora*, defined by the following shared derived characters: 'head pattern-males' (4) = head dominated by the crown; 'belly main colour-males' (33) = brown; 'belly extra colour-males' (35) = none; 'crown-females' (47) = scaly pattern; 'crown colour-females' (50) = green; 'chin hue-females' (69) = brownish; 'belly main colour-females' (81) = brown; 'belly hue-females' (82) = reddish. *C. aurora* presents several autapomorphies that separate it from *C. iris*, among others: 'crown hue-males' (3) = yellowish; 'upper back main colour-males' (9) = brown; 'chin main colour-males' (19) = blue; 'lower back extra colour-females' (63) = none; 'throat hue-females' (73) = brownish. *C. iris* is defined by the following autapomorphies: 'upper back extra colour-males' (11) = golden yellow; 'crown colour-females' (50) = green to orange-blue.

The terminal clade node 24→22 (*C. prunellei*, (*C.wilsoni*, *C. coeligena*)) is well-supported (jackknife value 96%), being defined by the synapomorphies: 'throat main colour-males' (23) = white; 'chest pattern-males' (28) = with two lateral white patches; 'throat pattern-females'

(71) = with two white lateral patches; ‘belly pattern-females’ (80) = borders different; ‘tail pattern-females’ (89) = all rectrices alike. *C. prunellei* represents the sister group of the clade *C. wilsoni – C. coeligena* (node 22→21) with the following autapomorphies (all with CI = 1.000): ‘lower back main colour-males’ (12) = black; ‘chest main colour-males’ (29) = black; ‘wing-coverts pattern-males’ (45) = blue and brown; ‘upper back colour-females’ (57) = black; ‘lower back main colour-females’ (61) = black; ‘wing-coverts pattern-females’ (93) = upper coverts blue, rest fuscous olive.

The clade *C. wilsoni – C. coeligena* (node 22→21) is also well-supported (jackknife value 86%), being defined by the following shared derived characters: ‘head colour-males’ (5) = brown; ‘head hue-males’ (6) = bronze-reddish; ‘nape-males’ (7) = brown; ‘lower back extra colour-males’ (14*) = green; ‘under tail-coverts main colour-males’ (37) = green; ‘rectrices main colour-males’ (42) = brown; ‘head colour-females’ (51) = brown; ‘head hue-females’ (52) = reddish; ‘nape colour-females’ (53) = brown. *C. wilsoni* is defined by the following autapomorphies: ‘upper back extra colour-males’ (11) = brown; ‘throat main colour-males’ (24) = violet; ‘chin main colour-females’ (68) = green; ‘chin hue-females’ (69) = greyish; ‘throat extra colour-females’ (74) = violet; ‘tail main colour-females’ (90) = green. *C. coeligena* is defined by the following unique characters: ‘upper back main colour-males’ (9) = brown; ‘chin main colour-males’ (19) = white; ‘chest pattern-males’ (28) = with discs and/or borders; ‘upper back colour-females’ (57*) = brown; ‘chin extra colour-females’ (70) = green; ‘throat pattern-females’ (71) = like the chin.

The other clade derived from node 32→31 includes the genus *Pterophanes* and the remaining species of *Coeligena*, being defined by the synapomorphies: ‘lower back hue-males’ (13) = no hue; ‘upper tail-coverts hue-males’ (16) = no hue; ‘belly extra colour-males’ (35) = none; ‘rectrices hue-males’ (43) = none; ‘throat main colour-females’ (72) = brown; ‘belly main colour-females’ (81) = brown. As already said, this clade divides into two parallel lineages: one with *Pterophanes cyanopterus* as the sister group of the clade *C. phalerata – C. helianthea* relatively well-supported (jackknife value 56%), and the other lineage (node 30→29) is also well supported (jackknife value 79%), being formed by the clade *C. bonapartei – C. eos* with *C. lutetiae* as the sister group.

The first clade (node 30→27) shows the synapomorphy: ‘tail pattern-females’ (89) = inner rectrix different. *Pterophanes cyanopterus* is characterised by the autapomorphies: ‘chin colour-males’ (19) = blue; ‘throat main colour-males’ (24) = blue; ‘chest colour-males’ (27) = like the throat; ‘remiges-males’ (46*) = blue and dark brown; ‘head colour-females’ (51) =

brown; ‘head hue-females’ (52) = green; ‘belly pattern-females’ (80) = medially different; ‘wing-coverts pattern-females’ (93*) = all blue; ‘bill compression’ (99) = lateral.

The terminal clade node 27→26 is poorly supported (jackknife <50%), although being well characterised by the following shared characters: ‘upper tail-coverts colour-males’ (15*) = blue; ‘under tail-coverts main colour-males’ (37) = brown; ‘chin extra colour-males’ (70) = none; ‘throat extra colour-females’ (74) = none; ‘tail pattern-females’ (89) = all rectrices alike. *C. helianthea* presents the following autapomorphies: ‘head colour-males’ (5) = black; ‘nape-males’ (7) = black; ‘lower back main colour-males’ (12*) = blue; ‘head colour-females’ (51) = black; ‘head hue-females’ (52) = greenish; ‘nape colour-females’ (53) = black; ‘lower back main colour-females’ (61*) = blue; ‘upper tail-coverts main colour-males’ (65*) = blue; ‘upper tail-coverts hue-females’ (66) = none; ‘belly main colour-females’ (81) = green; ‘belly hue-females’ (82) = blackish. The autapomorphies for *C. phalerata* are: ‘upper tail-coverts colour-males’ (15*) = white; ‘under tail-coverts main colour-males’ (37) = white; ‘rectrices main colour-males’ (42) = white; ‘crown-females’ (47) = frontal spot; ‘crown colour-females’ (50) = green; ‘chin hue-females’ (69) = reddish; ‘throat hue-females’ (73) = reddish; ‘tail main colour-females’ (90) = white.

The second clade 30→29, as mentioned above, is well-supported and is defined by the synapomorphies: ‘crown hue-males’ (3) = bluish; ‘head colour-males’ (5) = black; ‘remiges pattern-females’ (94*) = secondaries different; ‘remiges colour-females’ (95*) = brown and pale yellowish brown. This clade includes the terminal clade *C. bonapartei* – *C. eos* (node 29→28), which received very good support (jackknife value 96%), *C. lutetiae* being its sister group. This group shares the following apomorphies: ‘lower back main colour-males’ (12) = orange; ‘lower back hue-males’ (13) = greenish; ‘upper tail-coverts colour-males’ (15*) = orange; ‘upper tail-coverts hue-males’ (16) = yellowish; ‘belly main colour-males’ (33) = brown; ‘remiges-males’ (46*) = yellowish brown and dark brown; ‘head hue-females’ (52) = none. *C. lutetiae* is defined by the autapomorphies: ‘wing-coverts pattern-males’ (45*) = yellowish brown and dark brown; ‘upper tail-coverts hue-females’ (66) = reddish; ‘belly main colour-females’ (81) = green; ‘bill curvature direction’ (97) = upwards.

C. bonapartei is differentiated by the following autapomorphies: ‘crown hue-males’ (3) = yellowish; ‘head colour-females’ (51) = black; ‘nape colour-females’ (53) = black; ‘belly pattern-females’ (80) = with discs. *C. eos* presents the following autapomorphies: ‘head hue-males’ (6) = greenish; ‘upper tail-coverts hue-males’ (16) = green; ‘under tail-coverts main colour’ (37) = brown; ‘rectrices main colour-males’ (42) = brown; ‘rectrices hue-males’ (43)

= yellowish; ‘lower back main colour-females’ (61*) = orange; ‘lower back extra colour-females’ (63) = green; ‘upper tail-coverts main colour’ (65*) = orange; ‘upper tail-coverts hue-females’ (66) = greenish; ‘belly main colour’ (81) = orange; ‘tail main colour-females’ (90) = brown; ‘remiges colour-females’ (95*) = dark brown and pale reddish brown.

1.2 Discussion

The genus *Coeligena* belongs to one of the most basal lineages in the subfamily Trochilinae, being part of an Andean clade of highly polytypic genera (Bleiweiss *et al.* 1994, 1997). The phylogenetic reconstruction postulated here supports the monophyly of the *Coeligena* clade (consensus tree jackknifing 66%) and the close relationship of this group to *Heliodoxa*, which has been shown to be the direct sister group of the study genus *Coeligena* (Bleiweiss *et al.* 1997).

This phylogenetic reconstruction resolves the long-held assumption regarding a possible closeness of the genera *Ensifera* and *Pterophanes* to *Coeligena*, (Berlioz 1936, Fjeldså & Krabbe 1990, Schuchmann 1999), confirmed by the internal arrangement of both taxa (*Ensifera* and *Pterophanes*) within the ingroup formed by the *Coeligena* species.

On the other hand, the phylogenetic reconstruction excluded the taxon *Patagona gigas* from the main monophyletic group, placing it together with the basal outgroup *Sephanoides* rooting the tree. This very basal position of *Patagona gigas* indicates a possibly more ancestral status than the ‘brilliants’ lineage within the Trochilinae clades. For a more accurate conclusion regarding the latter taxon, it is highly recommended that an analysis of internal morphology (e.g., skeletal or muscular), comparative behaviour, as well as DNA comparisons be performed. Unfortunately, Bleiweiss *et al.* (1997) did not include the paradoxical taxa *Ensifera* and *Patagona* in their huge DNA-hybridisation matrix, still leaving open the discussion on where to place these large hummingbird species.

The monophyletic ingroup *Coeligena* seems to have gone through a complex speciation and diversification process, consisting of several diverging events evident at the base of the clade. The earlier event was the formation of two parallel lineages that emerged from the very base of the *Heliodoxa – Coeligena* node: one with the *torquata*-like forms and the other with the remaining taxa (the non-*torquata* forms of *Coeligena*, and the genera *Ensifera* and *Pterophanes*, see Fig. 3.1). These evolved into the smaller subterminal units ‘*helianthea* group’, ‘*lutetiae* group’, ‘*iris* group’ and ‘*coeligena* group’ (see below for explanations).

The *torquata* group forms a superspecies (nomenclature after Amadon 1966) integrated by four allospecies: *Coeligena* [*torquata*] *inca* as the more basal and first differentiated, then followed by *C.* [*torquata*] *torquata*. Some time later these two taxa experienced a differentiation process at both extremes of the distribution range, yielding the allospecies *C.* [*torquata*] *conradii* and *C.* [*torquata*] *insectivora*. *C.* [*torquata*] *insectivora* could represent a fully evolved semispecies (*sensu* Amadon 1966) in an advanced stage of parapatric speciation, separating the ranges of the taxa *C.* [*torquata*] *inca* and *C.* [*torquata*] *torquata*.

The second group or clade has *Ensifera* as the sister group of the ingroup that inlcudes the non-*torquata* species and *Pterophanes*. It is quite remarkable that irrespective of the presence of bill morphology characters in the matrix for the phylogenetic analysis, the deciding synapomorphies on which many clades are defined were those related to plumage coloration (see above). This coincides with Hilty & Brown (1986) affirmation that external bill characters (and perhaps body size) can be misleading indicators of higher level relationships like genera (in this case the extremely long bill in *Ensifera* and the overall large size of *Ensifera* and *Pterophanes*).

Nevertheless, interspecific mensural differences were found in both sexes (see Appendix), not directly related to the topology of the phylogenetic reconstruction, reflecting either the high dependence of such structures on the environmental characteristics of the occupied habitats, or simply representing autapomorphies at the lowest taxonomic (e.g., subspecific) levels. This ingroup diverges into two well-differentiated clades, one of them including the sexually monomorphic or less dimorphic species of *Coeligena*, and the other formed by *Pterophanes cyanopterus* and the more evolved (*sensu* Berlioz 1936) and much more dimorphic forms of *Coeligena*.

The divergence history of these two clades is the same for earlier stages, culminating in a later separation that produced very different extremely derived coloration patterns, like presence of complete sexual monomorphism in some forms, and/or decrease in dimorphism in others (see below).

In earlier classifications, the species included in the second clade were grouped into the genus *Helianthea* (Berlioz 1936) based on plumage colour similarities, and later into *Coeligena* by Peters (1945), presumably based on the principle of the name's priority; Peters did not explain the basis of his taxonomic treatments (see Species Accounts for details of the taxonomy). In this study, the group proved to be a consistent polymorphic unit, grouping in one clade the colourful taxa *C. phalerata* and *C. helianthea*, with *Pterophanes cyanopterus* as sister group

(the '*helianthea* group'). The origin of this group was probably strongly influenced by the geological history of the areas its members occupy (see next section). In the other clade, the species *C. bonapartei* and *C. eos* are placed together, with *C. lutetiae* as sister group, based on the autapomorphic coloration pattern on the wing feathers ('*lutetiae* group').

The species that form the ingroup of the clade, in which *Pterophanes* is included, are particularly colourful, with very restricted range compared with the widely distributed *Pterophanes cyanopterus*, the isolation being extremely marked in *C. phalerata*. This isolation led to the coloration differentiation and reduction in the overall size (herein another example of how misleading the external bill morphology can be: *C. phalerata* constitutes a very isolated group and has a bill length significantly longer than its sister taxa. See tables in Appendix for mean values and differences). The presence of conspicuous autapomorphies, like the white coloration on tail-coverts and rectrices, seems to be a tendency in isolated groups of this clade (see in Species Accounts the geographic variation in *C. violifer*, where the isolated subspecies *C. v. albicaudata* has also developed white coloration on and around the tail).

The '*lutetiae* group' can be considered as a superspecies, with its member all sharing a white-coloured wing pattern as autapomorphy. This superspecies includes the allospecies *C.* [*bonapartei*] *lutetiae* with a wide distribution range, *C.* [*bonapartei*] *bonapartei* with a patchy distribution, and *C.* [*bonapartei*] *eos*, with the most restricted range of the group, *C.* [*bonapartei*] *lutetiae* probably being the older species (in this case, the older species has the longer bill –see Appendix-). The latter two taxa possible originated by eventual isolation from the common ancestor, evolving a colourful plumage, similar to the present *C. helianthea*, but with quite different colours.

Based on this apparent similarity, it has been proposed considering *C. helianthea* and the members of the '*lutetiae* group' as allospecies, together with *C. violifer* (Schuchmann 1999), but the phylogenetic reconstruction in this study (also based on coloration) does not support this postulation, showing instead that although they belong to the same lineage, the relationship is at a more basal level.

The last basal divergence found involves those taxa with very reduced to absent plumage sexual dimorphism. The position of *C. violifer* at the base of the clade as sister group of the ingroup is somewhat puzzling but very well-supported (the jackknife support was very high: 90%). This lineage within *Coeligena* is mainly defined in both sexes by the predominance of brown coloration on the tail and its surroundings (see above for detailed synapomorphies). *C.*

violifer is at first sight problematic, due to its high intraspecific polymorphism: two of the three races in the northern part of the range present striking differences in plumage characters from the southernmost, and the third northern race shows an extreme change in tail coloration (from brown to white, see Species Accounts).

This observation suggests a parapatric speciation event in progress by the presence of a developing superspecies complex, constituted by two semispecies, *C.* (*violifer*) *osculans* in the north and *C.* (*violifer*) *violifer* in the south, and eventually three, if *C.* (*violifer*) *albicaudata* is considered different enough from *C.* (*violifer*) *osculans* (the parenthesis are used to indicate semispecies that are in process of superspecies formation, after Amadon 1966).

The sister group of the *C. violifer* complex diverged very early, as can be deduced from the two well-differentiated clades: the *iris* group and *coeligena* group, whose members have the reduction or complete absence of the crown metallic coloration in common. The *iris-aurora* species group is a polymorphic taxon that exhibits an extraordinary number of derived characters, probably acquired during the first isolation events and later accentuated by the patchy distribution pattern of the taxon. This original patchy distribution range is probably changing, as is evidenced by the zone of contact between races. This suggests that sexual isolation was and is incomplete or absent. Otherwise, *C. aurora* proved to be a fully differentiated species, apparently in sympatry with *C. iris*, presenting clearly defining autapomorphies.

The *coeligena* group of species is conformed by the only taxa group of *Coeligena* with a dull, absolutely monomorphic coloration pattern, being found on relatively low Andean slopes and related mountain ranges, excepting *C. prunellei*. The external aspect of the members of this clade is very similar, but each species shows important autapomorphies that certainly make them fully recognisable species. The phylogenetic reconstruction assigns *C. prunellei* as the sister group of the clade *C. coeligena – C. wilsoni*, based rather on differences than on similarities between the former and the two latter. This arrangement seems confusing, because usually the 'outgroups' in different clades within the lineages have wider geographic distribution than the members of the corresponding ingroup (e.g., *Ensifera ensifera*, *Pterophanes cyanopterus*, and *C. violifer* for this particular lineage). Nevertheless, it is interesting to note that the other clade that presents an outgroup with restricted restricted range is the *torquata* clade. These facts suggest a mixed radiation history of vicariance and

dispersal in all clades of *Coeligena* that influenced, and are still influencing, the current distribution and differentiation of the extant taxa.

2. Biogeography and Radiation Scenarios

In this section I introduce a plausible scenario of the speciation process and the reasons for the current geographic distribution, based on the assumption that the history of the taxa and the history of the area they occupy is the same (vicariance biogeography). This assumption has been supported by much evidence (Simpson 1975, Van der Hammen 1989, Bremer 1992, Fjeldså 1995, van Veller *et al.* 1999, Katinas & Crisci 2000, Brooks & McLemman 1991, García-Moreno & Fjeldså 2000).

The origin and diversification of the Andean trochilids of the *Coeligena* lineage date back to approximately the Mid-Miocene (12.76 Ma.), based on DNA-hybridisation evidence (Bleiweiss *et al.* 1994, 1997), though according to the geological and phylogenetic evidence, it is possible that its origin is older, likely close to the beginning of the first important Andean uplifts (*c.* late Paleocene, see below).

The uplift sequence of the Andes was not continuous, but rather asymmetric, and in general followed a south-to-north progression, leading to a corresponding evolutionary response (speciation) of the taxa found along the Andean cordilleras (see Simpson 1975 and Doan 2003 for a detailed geological review). Lately, Doan (*op. cit.*) proposed a south-to-north speciation hypothesis (SNSH) for members of the Andean biota that share the same history (monophyletic), which can be plausibly applied to the *Coeligena* group.

Since *Coeligena* is a monophyletic group with an exclusively Andean distribution, a Brooks Parsimony Analysis (BPA) was performed in order to explain the biogeography of the areas and the radiation scenario of *Coeligena* and its allied taxa (*Pterophanes* and *Ensifera*), and contrast the SNSH as the possible speciation model for these taxa.

Fig. 3.2 depicts the three clades extracted from the phylogenetic trees, the product of the phylogenetic reconstruction (see previous section). The first clade (Fig. 3.2 above right) is defined as indicated below:

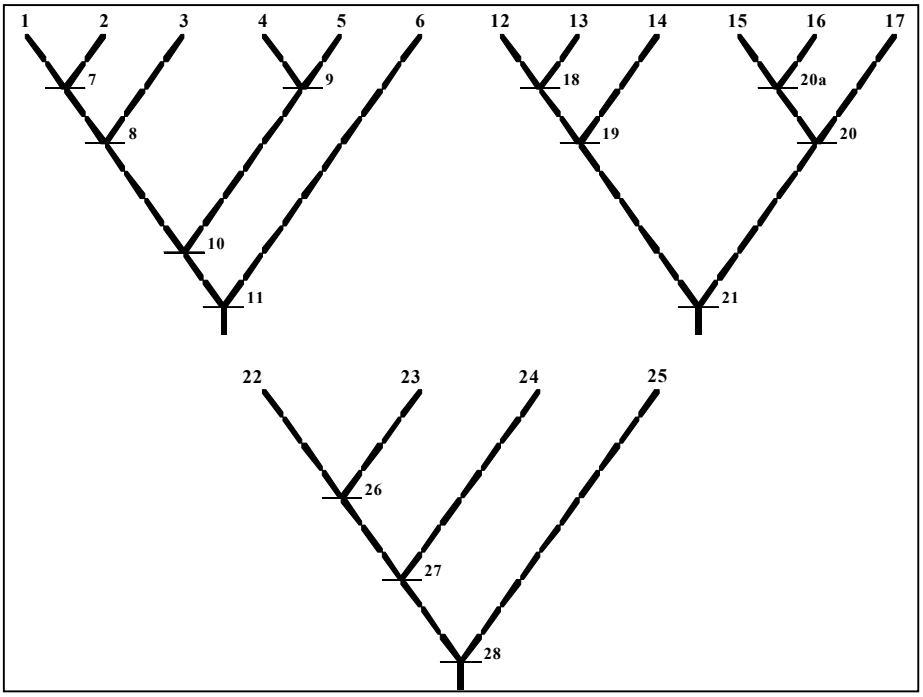


Figure 3.2. Phylogenetic trees of the three examined *Coeligena* clades. The numbers at the top of the branches represent the species, the slashes the ancestors. **1**: *C. coeligena*; **2**: *C. wilsoni*; **3**: *C. prunellei;* **4***: C. iris*; **5**: *C.aurora*; **6**: *C. violifer;* **12**: *C. phalerata*; **13***: C. helianthea*; **14**: C. (*=Pterophanes). cyanopterus*; **15**: *C. bonapartei*; **16**: *C. eos*; **17**: *C. lutetiae*; **22**: *C. conradii*; **23**: *C. insectivora*; **24**: *C. torquata*; **25**: *C. inca*.

1. (*C. violifer*, (*Coeligena prunellei*, (*C. coeligena*, *C.wilsoni*),(*C. iris*, *C. aurora*));

2. ((*Coeligena* (*=Pterophanes*) *cyanopterus*, (*Coeligena phalerata*, *C. helianthea*)), (*C. lutetiae*, (*C. eos*, *C. bonapartei*)); and

3. *Coeligena inca*, (*C. torquata*, (*C. insectivora*, *C. conradii*))).

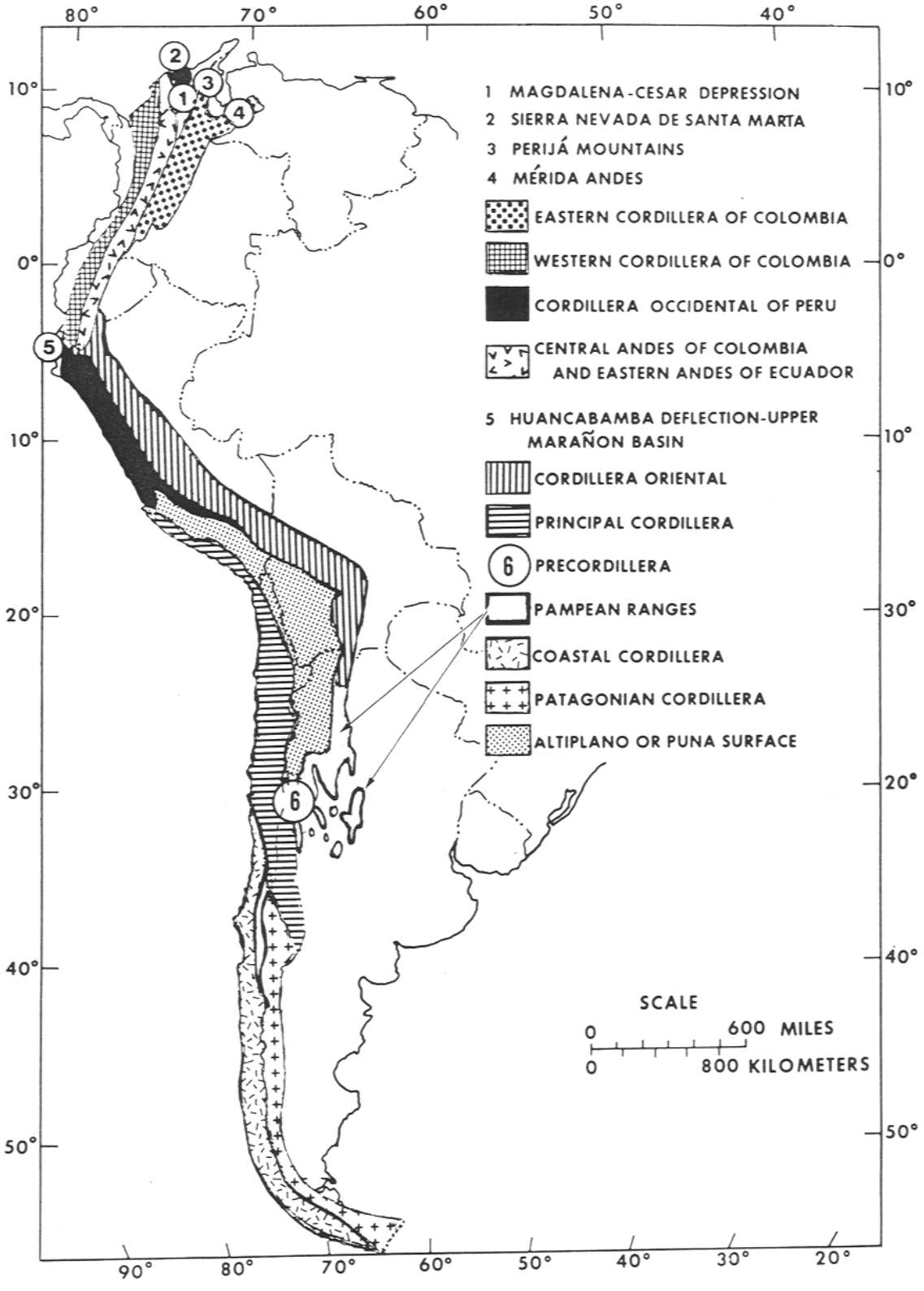


Figure 3.3.South America map showing the areas employed by the BPA analysis (taken from Simpson 1975). The polygons represent the geological units considered in this study. The codification used for the area cladogram is: **A1**: Sierra Nevada de Santa Marta, **A2**: East Cordillera of Colombia, **A3**: Central Andes of Colombia and East Andes of Ecuador, **A4**: Western Cordillera of Colombia and Ecuador, **A5**: Cordillera Occidental of Peru, **A6**: Cordillera Oriental of Peru, and **A7**: Bolivian Altiplano.

Coeligena (=*Ensifera*) *ensifera* was excluded from the analysis because it is not part of any monphyletic sub-clade, appearing as the outgroup of the first and second clades. The genus *Patagona* was also excluded since it does not belong to the major monophyletic group. These exclusions did not affect the results due to the wide distribution of both genera (actually two species, being both monotypic), found in all the areas examined. This redundant occurrence would be signalled by the analysis as homoplasy on every single branch of the area cladogram.

Figure 3.4. shows the same cladogram with the areas examined, constructed on the phylogenetic relationships of the species included in the three clades of *Coeligena*. The internal branches are numbered, the number at the top of each terminal branch corresponding to one species. Tab. 3.2 lists the binary codes for members of each clade for each area.

Table 3.2. Primary matrix listing the geographical distribution of three clades of *Coeligena – Pterophanes* taxa, along with the binary codes representing the phylogenetic relationships for all three clades. '?' = species missing from the area. For areas explanation see Fig. 3.2.

Area	Taxa	Nodes	Binary code
A1	12	18,19,21	?????????? ?100000110 01????????
A2	1,3,13,14,15,16,22,24	7,8,10,11,18,19,20,20a,21,26,27,28	1010001101 1011110110 111010111
A3	1,14,17,24	7,8,10,11,19,21,20,27,28	0000001101 1001001111 010010011
A4	2,24,15,17	7,8,10,11,20,20a,21,27,28	0100001101 1000101001 010010011
A5	4,5	9,10,11	0000100011 1????????? ?????????
A6	1,4,6,9,14,23,25	7,8,10,11,19,21,26,27,28	1001011111 1001000110 010101111
A7	1,6,25	7,8,10,11,28	1000011101 1????????? ??0001001

The primary BPA analysis for the three clades (based on the area-taxa matrix from Tab. 3.2) produced only one tree, with a consistency of 80% (tree-length = 35 steps, Fig. 3.6). The primary BPA provides strong support for a vicariance relationship between the areas A5 (Cordillera Occidental of Peru), A4 (Western Cordillera of Colombia and Ecuador) and A1 (Sierra Nevada de Santa Marta) in a south – north direction, moderate support for those areas plus A3 (Central Andes of Colombia and Eastern Andes of Ecuador) and A2 (Eastern Cordillera of Colombia, including the Perija and Merida ranges).

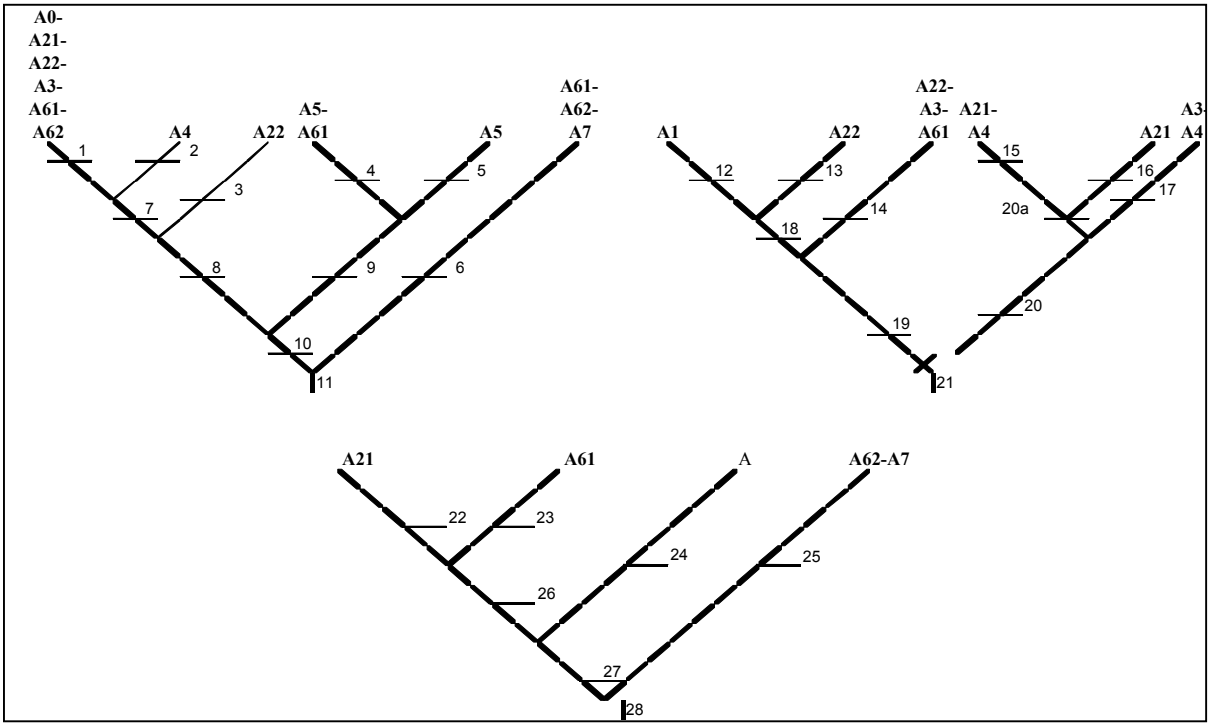


Figure 3.5. Phylogenetic trees with the areas. The areas correspond to the geographic range of the species that were originally at the top of each branch in Fig. 3.2. For area coding see Fig. 3.2.

No support a vicariance relationship was found between the areas A6 (Cordillera Oriental of Peru) and A7 (Bolivian Altiplano) suggesting the occurrence of a differentiation process, other than vicariance.

Examination of the homoplasy in the primary BPA cladogram area (numbers with asterisk in Figs. 3.6. and 3.7.) resulted in one case for A5 and A1, and four cases for A2, A3, A4, A6, and A7.

When these latter areas were duplicated for a secondary BPA (Tab. 3.3), it was discovered that replications of A4 were superfluous, the only required replicates being of A2, A3, A6, and A7 to fully explain the homoplasy on the tree. The secondary BPA produced three equally parsimonious area cladograms (89.6%, tree-length = 29), which collapsed to one consensus cladogram (Fig. 3.7).

I found that the 'ancestor' forms for clade 1 and 3 are present at the root of the area cladogram, and the differentiation of the third lineage (clade 2) appears later, along the main tree branch. Homoplasy and reverses in the area cladogram were interpreted either as dispersal events of the extant taxa (as well as of their ancestors, depicted as the nodes in the phylogenetic reconstruction) from their ancestral areas, or as later parapatric speciation (see below); absences are interpreted as extinction or secondary loss of the taxon from the area.

Table 3.3. Secondary matrix listing the geographical distribution of three clades of *Coeligena* – former *Pterophanes* taxa, along with the binary codes representing the phylogenetic relationships for all three clades. '?' = species missing from the area.

Area	Taxa	Nodes	Binary code
A1	12	18,19,21	?????????? ?100000110 01???????
A2	1,3,14,15,16,24	7,8,10,11,18,19,20,20a,21,27,28	1000001101 1001110011 110010011
A21	13,22	18,19,21,26,27,28	?????????? ?010000110 011000111
A3	1,17,24	7,8,10,11,21,20,27,28	1000001101 1000001001 010010011
A31	14	19,21	?????????? ?001000010 01???????
A4	2,24,15,17	7,8,10,11,20,20a,21,27,28	0100001101 1000001001 010010011
A5	4,5	9,10,11	0000100011 1????????? ?????????
A6	1,4,6,14,23,25	7,8,10,11,19,21,26,27,28	1000001101 1001000010 010100111
A61	9	10,11	0000000011 1????????? ??0001001
A7	6,25	11,28	1000011101 1????????? ??0001001
A71	1	7,8,10,11	?????????? ?001000010 ?1????????

From the area cladogram can be inferred that clades 1 and 3 are older than of clade 2, their radiation history being parallel, with their origin in the southern Andes of Peru and Bolivia (taxa 11 and 28 at the root of the cladogram). Considering that this was the first part of the current Andes to be uplifted (Simpson 1975), the divergece of the *Coeligena* lineage from the Trochilinae stem line can be dated to an older age than the Bleiweiss *et al.* (1994) Mid-Miocene estimate. It can be speculated that the lineage ancestor was present in the Pre-Andes of the Eocene (*c.* 50 Ma.), based on evidence that the extant Trochilidae group had already differentiated from the stem 'swift-like Apodiformes' in the Mid Eocene (Mayr 2003).

The divergece of the clade 2 can be estimated to have occurred later (taxon 21 before the second branch of the area cladogram), presumably after the last uplift of the East Ecuadorian and Central Colombian Andes, in the Paleocene. For this reason, extant members of each clade (species) reached their current geographical distribution independently, and in order to avoid confusion the individual speciation scenarios for each clade will be treated separately, the uplift events and their temporal scale are depicted in the Fig. 3.6.

CLADE 1 (Fig. 3.1) had its origin in the southern Andes of Peru and extended northwards, along with the uplift of the Cordilleras Oriental and Occidental of Peru (taxon 10), and southwards to the Bolivian Altiplano during the Miocene. The formation of the deep and arid River Marañon Valley (late Miocene) caused the diverging of the species *Coeligena violifer* (terminal taxon 6), which later, due to the geological changes during the Pliocene-Pleistocene glaciation, divided into four sub-forms in a south-to-north direction, each corresponding to the currently recognised subspecies (see Species accounts).

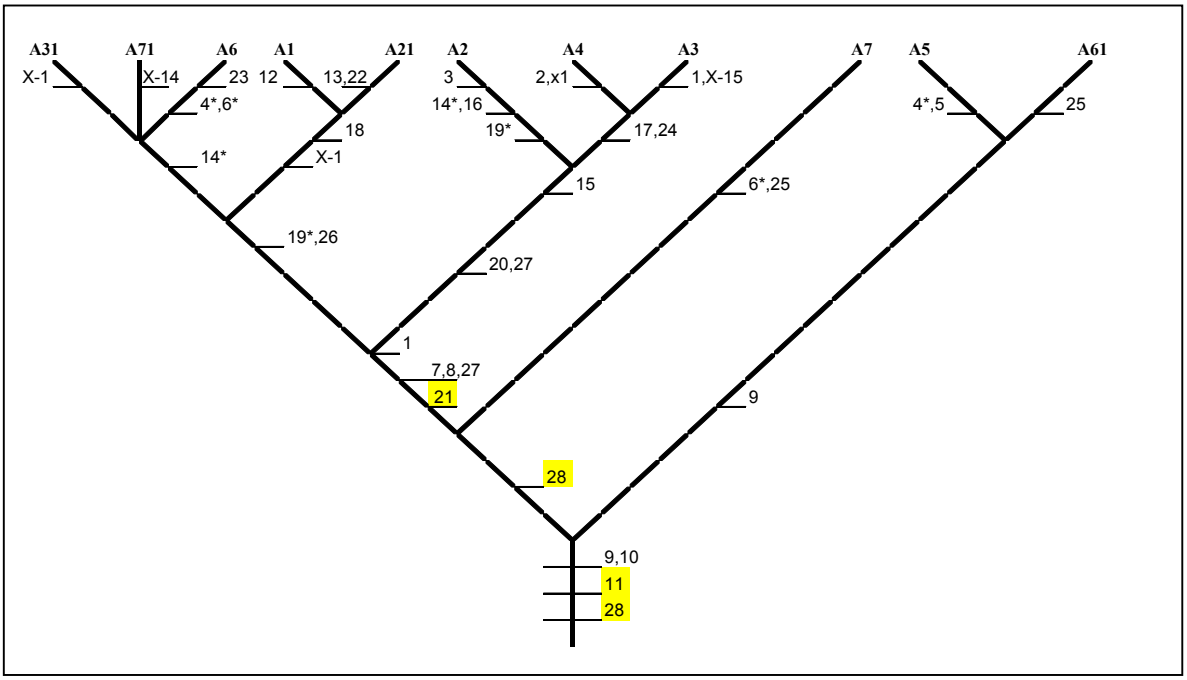


Figure 3.6. Parsimonious area cladogram produced from primary BPA of three clades of genus *Coeligena* and former *Pterophanes*; points of congruence (homoplasies) are marked with an asterisk. The numbers 11, 21, and 28 represent the 'ancestral taxon' for each clade. Remainder numbers accompanying slash marks refer to species code (from Fig. 3.2 and Tab. 3.3).

The uplift of the Cordillera Occidental of Peru occurred in several periods, whereas the final uplift can be dated to the first and second Pleistocene ice advances. These events isolated part of the ancestral population, which dispersed along both Peruvian Cordilleras (homoplasy of taxon 9), producing the differentiation of the species *Coeligena iris* and *C. aurora* (terminal taxa 4 and 5, respectively). The current range of these taxa is very patchy, the product of several isolations events during the Quaternary, causing a pronounced polymorphism between the populations. Probably the sympatry observed between *C. iris* and *C. aurora* is secondary, being caused by a recent dispersal of the north Peruvian *C. iris* populations (*C. iris iris*).

The widely distributed ancestral population (taxon 8) followed the uplift of the Andes in a northerly direction, occupying the newly formed mountain ranges from Ecuador to Venezuela and yielding a form adapted to lower altitudes (above 2000 m) that rapidly dispersed northwards (taxon 7). The high-altitude relict ancestral form differentiated into the species *C. prunellei* (terminal taxon 3), today with a very restricted distribution range. During the Miocene, the re-uplift of the Western Cordillera of Colombia and Ecuador split the ancestral taxon 7 producing the complete differentiation of the species *C. wilsoni* (terminal taxon 2) and

C. coeligena (terminal taxon 1). Populations of the latter species on the eastern slopes of the Colombian Andes dispersed very quickly southwards and northwards, occupying a lower altitude zone along the Andes (homoplasy of the taxon 1).

Later geological events during the Tertiary and early Quaternary produced fragmentations of the early continuous mountain range, e.g., the separation from the East Andes of Colombia of the Cordillera of Perija by the Maracaibo Depression (Tertiary) and the Cordillera de la Costa in Venezuela by the Barquisimeto Depression (Quaternary), which consecutively produced subspecific differentiation. If it can be proved that the more isolated forms (*C. coeligena coeligena* in Venezuela, *C. c. ferruginea* in the West Cordillera of Colombia and Ecuador, and *C. c. boliviana* in Bolivia) already have reached the reproductive isolation, a parapatric speciation could be invoked. The absences on some of the area cladogram branches are better explained as unsuccessful dispersal into these areas (to assume extinction would be the less parsimonious reason, thus resulting in a violation of the Henning Auxiliary Principle).

CLADE 2 (Fig. 3.2, taxon 21) had a younger origin farther north than the other two. The area of origin can be allocated to the Andes of Colombia and Ecuador, in the Mid-Miocene (16 Ma.), being isolated from the *Coeligena* stem line during the erosion and volcanic episodes of the late Tertiary. The ancestral group diverged in two lineages after the uplift of the Eastern Cordillera of Colombia: one north (taxon 19) and the other south of the Colombian and Ecuadorian Andes (taxon 20). Both lines experienced a very complex differentiation process, influenced by climatic and geological changes during the Quaternary. It is most likely that the already differentiated taxon 20 dispersed northwards, existing in sympatry with taxon 19, while the population that stayed in the Central Andes of Colombia differentiated, forming the species *C. lutetiae* (terminal taxon 17), which eventually dispersed northwards.

After the uplifting of the West Cordillera of Colombia and Ecuador, the northern taxon 20 probably had an ancestrally wide distribution, reaching the Perija Cordillera in northern Colombia and the Venezuelan Andes, but the separation of these components of the Andes in the Tertiary (Maracaibo Depression) produced a contraction of the ranges, leaving one relict in the Venezuelan Andes that differentiated in the species *C. eos*, and another in the species *C. bonapartei*, with a relict population on the Perija mountain range. The populations of *C. lutetiae* suffered the same split, giving rise to two subspecies on both slopes of the Ecuadorian Andes (see Species Accounts). The lineage of taxon 19 experienced another form of divergence, that led to *Coeligena cyanopterus* (taxon 14, this species has always been

included in the genus *Pterophanes*, see above), which successfully dispersed southwards, and is now found along the eastern slopes of the Andes from the Eastern Cordillera of Colombia to southern Peru (homoplasy on the area cladogram). The absence of this taxon can be solved with the same argumentation as with *C. coeligena* (e.g.,absence in the Bolivian Altiplano, see clade 2 explanation).

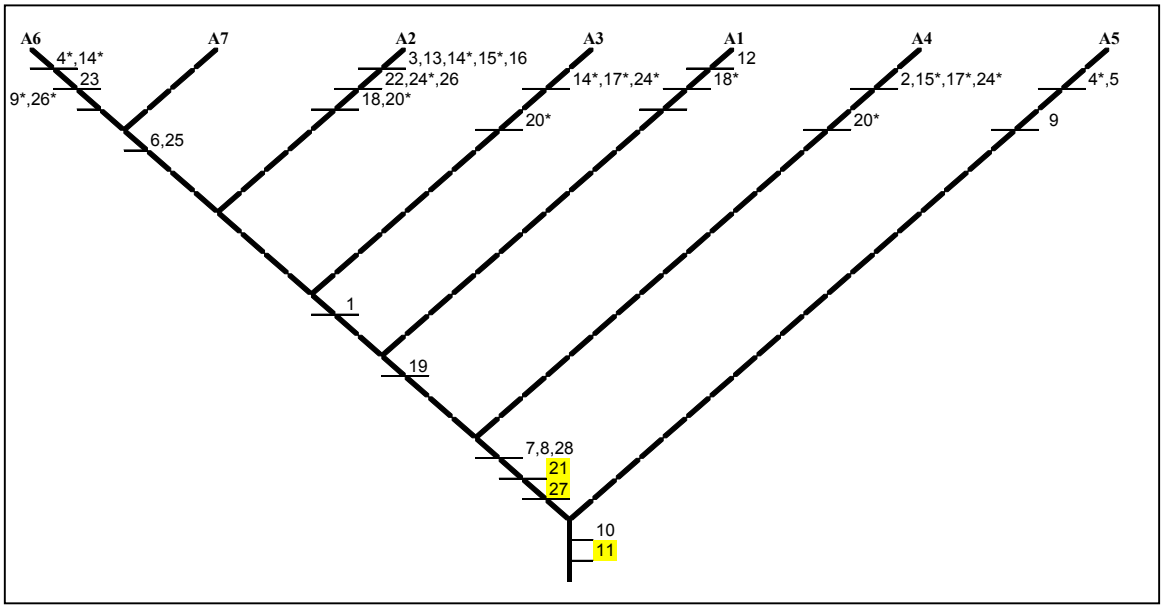


Figure 3.7. Parsimonious area cladogram produced with the secondary BPA with three clades of genus *Coeligena* and former *Pterophanes*; points of congruence (homoplasies) are marked with an asterisk. The numbers 11, 21, and 27 represent the 'ancestral taxon' of each clade. Remainder numbers accompanying slash marks refer to species code (from Fig. 3.2 and Tab. 3.3).

The northernmost differentiated group (taxon 18) reached north-eastern Colombia (Sierra de Perija) and the southernmost the Venezuelan Andes. The abrupt elevation of the Sierra de Santa Marta during the Pliocene (*c.* 1000 m uplift) isolated its populations, giving rise to the species *C. phalerata* (terminal taxon 12, defined by several exclusive derived characters, see previous section and Species Accounts). The other branch formed the species *C. helianthea*, in north-eastern Colombia, with an isolated relict population on the Paramo de Tama, probably the product of migration and subsequent isolation during the Pleistocene glaciation.

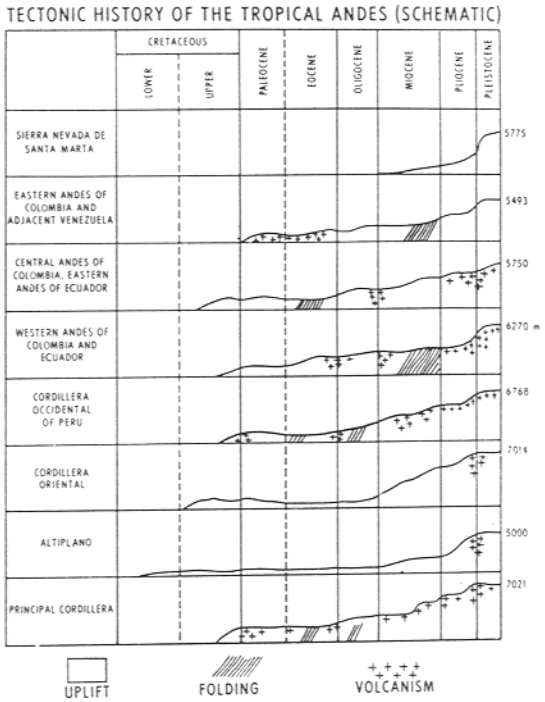


Figure 3.6. Andes uplift progression, the different geological events, and the time scale are depicted (taken from Simpson 1975).

CLADE 3 (Fig. 3.2) is the oldest lineage of the *Coeligena* clade, originating in the southern Andes of Peru and northern Bolivia. The clade is composed of four allopatric polymorphic species (with one exception); its speciation is very well-supported by vicariance (absence of homoplasy on the area cladogram). The first species differentiated very early (late Eocene) in the form *C. inca*, which dispersed southwards to the Bolivian Altiplano, forming two subspecies; the northern, ancestral fraction settled widely from southern Peru to the Venezuelan Andes, following the progressive uplift of the Andes.

The separation of the Merida Andes from the remaining range during the Tertiary and Quaternary caused the differentiation of the species *C. conradii*, which lost several of the distinct characters common to the clade, and the remaining population diverged in the species *C. torquata*, which during the uplift of the West Cordillera of Ecuador was divided into two populations. This separation must have be relatively recent, judging by the poor differentiation of the subspecies on both slopes of the Andes. Later the formation and enlargement of the river Marañon valley divided the southernmost population of *C. torquata*, initiating the parapatric speciation of this population in the form *C. insectivora*, which still shares many features with the parental species, whereas the separation is old enough to have produced polytypes within the group (three geographically isolated subspecies, see Species Accounts).

The *Coeligena* group, as other members of the Andean biota, showed a direct response to the progressive sequential south-to-north uplifting of the mountain range as proposed by Doan (2003). The more decisive speciation process is the vicariance, being more finely modulated by other geological events, such as the Pleistocene ice expansions. Simultaneous and comparative study of other Andean elements (trochilids as well as other groups) would afford the most accurate and perhaps final verification of the model proposed here.

Based on this hypothetical speciation model, constructed on the phylogenetic relationships between taxa and areas, it is possible to make predictions on how the speciation process proceeds in a closely related taxon. In this sense, considering that *Coeligena* (*Ensifera*) *ensifera* is a basal group in the *Coeligena* clade, being actually the sister group of clades 1 and 2 (this implies it would be somewhat younger than clade 3). I am confident in affirming that its origin was also in the extreme south of the Andes, but that it did not respond to the vicariance process as the other groups did, and was capable of dispersing through all the Andes yet presenting no important geographic variation between populations, although many are apparently isolated.

The resulting hypothesis of this study differs in some aspects from the speciation models proposed for other Andean taxa. Many studies on geographic variation and biogeography of Andean trochilids have been carried out with close related taxa such as *Eriocnemis* (Schuchmann *et al.* 2001a), *Haplophaedia* (Schuchmann *et al.* 2000), *Ramphomicron* (Weller & Schuchmann 2002), *Boissonneaua* (Schuchmann *et al.* 2001b), and the *Heliodoxa* genera group, including *Sephanoides* (Renner 2000) All these works propose Pleistocene climatic fluctuations and glacial ice-front advances as the main modelling factors of the speciation and distribution patterns of the extant taxa, with subsequent colonisation events (dispersal).

In these hypotheses a lowland origin for the Andean fauna is proposed, with subsequent migrations to the surrounding highlands that emerged in the late Pleistocene. This agrees in general with Bleiweiss' (1998) reconstruction of hummingbird origins, who based his conclusions on phylogenetic reconstructions of trochilids lineages (Bleiweiss *et al.* 1994, 1997). In addition, a reconstruction of the ancestral characters at the genus level was presented. The group diversification and basal separation of the genera *Eriocnemis* and *Heliodoxa* from the sister group *Coeligena* within the 'brilliants' lineage would have taken place at the end of the Tertiary (Late Miocene). *Coeligena* species radiation would have begun later, in the Mid-Pliocene (before the Quaternary), as a byproduct of coevolution and ecological adaptations to the new relative isolated habitats.

Some crucial differences are found if the biogeographic hypothesis for *Coeligena* species presented in this study is compared with those obtained in studies on closely related Andean taxa like *Eriocnemis*, *Heliodoxa* (Bleiweiss *et al.* 1997), *Sephanoides* (Renner 2000, Schuchmann 1999), and *Haplophaeia* (Schuchmann *et al.* 2000).

Schuchmann *et al.* (2000) state that *Haplophaeia* species, contrary to other hummingbird taxa, have their centre of origin and evolution in the northern Andes, subsequently expanding from this region. The phylogenetic relationships within the genus were based on morphological and behavioural synapomorphic characters. Phylogentic relationships with the taxa *Eriocnemis* and *Urosticte* were suggested. The initial separation of a 'proto-*Haplophaeia*' population was probably completed before the Pleistocene but after the final rise of the High-Andean crest. The colonisation of the current range occurred as gradual invasions initiated during each glacial period.

Renner (2000) proposes a complicated hypothetic scenario to explain the radiation of the genera *Heliodoxa* and *Sephanoides*. In his study, the phylogeny of the group is not completely solved, *Sephanoides* being presented - instead of *Heliodoxa* - as the sister group of *Coeligena*. Renner proposes a lowland origin for *Heliodoxa*, in western Brazil, and explains the current Andean ranges as the result of possible colonisations via the eastern slopes in southern Peru, which later continued northwards reaching the northern Andes. *Sephanoides* species show a southern origin, their dispersion being southwards reaching Patagonia, and westwards to the Juan Fernández Island.

Schuchmann *et al.* (2001a) analyse the biogeography and speciation pattern of *Eriocnemis*. The biogeographic hypothesis for the origin and radiation of *Eriocnemis* species is similar to that proposed for *Haplophaeia* (see above, Schuchmann *et al.* 2000), with the centre of origin located in the northern Andes of Colombia, thus agreeing with the hypothesis postulated for other Andean vertebrates. In this hypothesis, as well as in the *Haplophaeia* study, Pleistocene climatic fluctuations are the main factor modelling radiation and current distribution patterns, and the conclusions are based on the occurrence or frequency of determined characters (plesiomorphies or apomorphies) in extant populations regardless of the earlier geological history of the region. In both analyses, dispersal is the principal process invoked to explain current geographic ranges.

The biogeographic hypothesis presented in this study differs in many aspects from those mentioned above. These differences not only encompass the conclusions but also the approaches used here. The hypothesis postulated here represents a testable model of

speciation. Putative speciation models, like those described above, are based upon the interpretation of the geographic distribution, the phenotypic characteristics of populations, and the geo-historical events. These are models difficult or impossible to test (Graves 1982).

For this study, the phylogenetic reconstruction was obtained first of all because it was required for biogeographic analyses (Shapiro 1989, Brooks & McLemman 1991). Once the relatedness between species was known, it was possible to deduce their diversification history. The determination of the common history (monophyly) and the phylogenetic relationships within one group allow us to couple these with the evolution of the area occupied by the taxa. Because no current phylogenetic reconstruction for the genus *Coeligena* existed, this study closed the gap, using the phylogenetic hypothesis here proposed for the biogeographic analysis.

In this study, an early origin for the *Coeligena* species is assumed, earlier than the Pleistocene, contemporary with the Andean uplift progression. This assumption does not discard the effects of Pleistocene events on the differentiation of *Coeligena* populations, but it is considered to have more probably affected speciation at the subspecific level (almost all the evidence indicating a Pleistocene origin of the Andean avifauna was obtained from Passeriformes taxa, which are known to be the most recently differentiated bird order (see Fjeldså *et al.* 1999). Here vicariance is considered the main modelling factor of the current range and speciation of *Coeligena* species. The importance of vicariance is supported by other studies on Andean small mammals, where a vicariant (allopatric) speciation model is favoured in order to explain patterns observed in extant taxa (Patton *et al.* 1989, Patton *et al.* 1990).

Based on the geological history of the Andes, a southern origin is proposed for *Coeligena*, located on the south-western slopes of the present Peruvian Andes. The colonisation of new habitats was determined by the progressive Andes uplift and followed a general south-to-north direction, with some exceptions, caused by occasional further uplift events in the south.

This model coincides with the general speciation proposed for several hummingbird genera such as *Aglaiocercus* (Schuchmann & Duffner 1993), *Chalcostigma* (Schuchmann & Heindl 1997), and *Metallura* (Heindl & Schuchmann 1998). Nevertheless it is important to note that the radiation scenario for these hummingbirds has been proposed for the Pleistocene. Moreover, I prefered to compare my scenario with phylogenetically nearer taxa (member of the same lineage) because of high probability that they shared speciation processes. That is the case of the speciation scenario reconstruction of *Sephanoides* and *Helidoxa* species (Renner 2000).

Sephanoides species show an exclusive southern Andes range, with some representatives on the Juan Fernández Islands. In my phylogenetic reconstruction, *Sephanoides* is more basal than *Heliodoxa* and the monophyletic *Coeligena* supporting the southern origin of the 'brilliant' lineage. Once the last elevation of the northern Andes (late Pliocene and early Pleistocene) was reached, isolation, a consequence of glacial advances and the formation of new geographic barriers, led to parapatric as well as allopatric differentiation, which still are in progress and will probably lead to the complete differentiation of isolated populations.

The other taxon studied here was *Patagona gigas*, which is also an Andean component. The phylogenetic reconstruction excluded it from the monophyletic *Coeligena* group, being placed basally, together with *Sephanoides*. The speciation model would predict for *Patagona* subspecies a very similar differentiation process as the one observed in the other taxa studied (a southern origin and successful dispersal in a northerly direction).

In fact, *Patagona* populations show a south-to-north divergence at a subspecific level, probably caused by vicariance during the uplift of the Cordillera Oriental and Occidental of Peru (before the Miocene), but the isolation was not complete; contact zones were detected near the River Madre de Dios, in Peru (see Species Accounts), caused in part by the migrational behaviour of the group. The curious division of the southernmost population could originate in the relatively recent uplift of the Principal Cordillera (northern Chile and Argentina), but as in the case of *Ensifera ensifera*, this taxon did not respond to the vicariance process with diversification, being still in dispersal to the north as shown by the recent evidence (Ortiz-Crespo 1974), reaching Colombia (Fjeldså & Barbosa 1983, this observation could be a wrong identification, Schuchmann, pers. comm.).

3. Taxonomic Conclusions

Based on the morphometric and plumage colour analyses, several taxonomic rearrangements within the species of the genera *Coeligena*, *Pterophanes*, *Patagona*, and *Ensifera* are proposed. These changes are presented in the following list, including the revised geographical distribution of each taxon (from north-east Venezuela to south-west Chile and north-east Argentina).

1. Genus ***Coeligena*** Lesson, 1832: includes 14 species:

> 1.1. ***Coeligena coeligena*** (Lesson 1832): polytypic, ranging from the Cordillera Oriental in eastern Venezuela, and from the Sierra de Perija, on the border of Venezuela and Colombia, southward, in the East, Central and West Andes, along the

western slopes, to south-east Bolivia, altitude between 700 – 1500 m. It includes six subspecies:

1.1.1. ***Coeligena coeligena coeligena*** (Lesson 1832): from north-east Venezuela (Anzoátegui) to the Sierra de San Luis and the westernmost part of the Cordillera de la Costa (Lara), western Venezuela.

1.1.2. ***Coeligena coeligena zuliana*** (Phelps & Phelps 1953): restricted to the Sierra de Perijá, on the border of Venezuela and Colombia.

1.1.3. ***Coeligena coeligena columbiana*** (Elliot 1876): from the northernmost part of the East Andes, in western Venezuela, to the western bank of the River Marañon, northern Peru.

1.1.4. ***Coeligena coeligena ferruginea*** (Chapman 1917): in the Central and West Andes, in western Colombia.

1.1.5. ***Coeligena coeligena obscura*** (Berlepsch & Stoltzmann 1902): from northern Peru, on the eastern bank of the River Marañon, to north-west Bolivia (La Paz).

1.1.6. ***Coeligena coeligena boliviana*** (Gould 1861): restricted to the Yungas of Bolivia (north of Santa Cruz).

1.2. ***Coeligena phalerata*** (Bangs 1898), monotypic, restricted to the Sierra de Santa Marta, northern Colombia, altitude between 1700 – 3300 m.

1.3 ***Coeligena conradii*** (Bourcier 1847): monotypic, restricted to the paramos of Mérida, in the Venezuelan Andes, altitude 1500 – 4000 m.

1.4. ***Coeligena torquata*** (Boissonneau 1840): polytyptic, ranges from the East Andes, on the border of Venezuela and Colombia to northern Peru, along the eastern slopes of the Colombian and north Peruvian Andes and on both slopes of the Ecuadorian Andes. It comprises two subspecies:

1.4.1. ***Coeligena torquata torquata*** (Boissonneau 1840): from the paramo of Tama, on the border of Venezuela and Colombia to northern Peru on the eastern slopes of the Andes, altitude above 1800 m.

1.4.2. ***Coeligena torquata fulgidigula*** (Gould 1854): on the western slopes of the Ecuadorian Andes (Pichincha region).

1.5. ***Coeligena bonapartei*** (Boissonneau 1840): polytypic, exhibits a discontinuous range that comprises the Sierra de Perijá in north-east Colombia, on the border with Venezuela, the western slopes of the East Andes, in central Colombia, and on the West Andes, altitude between 1800 – 3200 m. It includes three subspecies:

1.5.1 ***Coeligena bonapartei consita*** Wetmore & Phelps 1952: restricted to the Sierra de Perijá, on the border of Venezuela and Colombia.

1.5.2. ***Coeligena bonapartei bonapartei*** (Boissonneau 1840): in the Cundinamarca region, on the western slopes of the East Andes of Colombia.

1.5.3. ***Coeligena bonapartei orina*** (Wetmore 1953): known only from one specimen collected in the paramo Frontino, in the West Andes of Colombia.

1.6. ***Coeligena eos*** (Gould 1848): monotypic, restricted to the Merida paramos in the Venezuelan Andes, altitude above 2500 m.

1.7. ***Coeligena helianthea*** (Lesson 1838): polytypic, restricted to the East Andes of Colombia, altitude between 1600 – 3000 m. It includes two subspecies:

1.7.1. ***Coeligena helianthea tamai*** Berlioz & Phelps 1953: restricted to the paramo of Tama, on the border of Venezuela and Colombia.

1.7.2. ***Coeligena helianthea helianthea*** (Lesson 1838): on the western slopes of the East Andes of Colombia, from Santader to Cundinamarca.

1.8. ***Coeligena prunellei*** (Bourcier 1843): monotypic, restricted to the valley and eastern bank of the River Magdalena, on the western slopes of the Colombian East Andes, altitude above 1800 m.

1.9. ***Coeligena lutetiae*** (DeLattre & Bourcier, 1846): polytypic, ranges from the Central Andes of Colombia to northern Peru, on the eastern slopes, and on the western slopes of the Ecuadorian Andes, altitude between 1700 – 4000 m. It includes two subspecies:

1.9.1 ***Coeligena lutetiae lutetiae*** (DeLattre & Bourcier 1846): on the eastern slopes of the Andes, from the Colombian Central Andes to northern Peru.

1.9.2. ***Coeligena lutetiae*** **ssp. nov.:** restricted to the Pichincha region, on the western slopes of the Ecuadorian Andes.

1.10. ***Coeligena wilsoni*** (DeLattre & Bourcier 1846): polytypic, ranges from the Central and West Andes of Colombia to the western slopes of the Ecuadorian Andes, altitude between 1000 – 2400 m. It includes two subspecies:

1.10.1 ***Coeligena wilsoni wilsoni*** (DeLattre & Bourcier 1846): in the Central and West Andes of Colombia, from Quindio to Puracé, along the River Cauca.

1.10.2. ***Coeligena wilsoni*** **ssp. nov.**: on the western slopes of the Andes, from south Colombia to south Ecuador.

1.11. ***Coeligena violifer*** (Gould 1846): polytypic, found only on the eastern slopes of the northern Peruvian Andes to the northern Bolivian Andes, altitude between 2800 – 4400 m. It includes four subspecies.

1.11.1. ***Coeligena violifer dichroura*** (Taczanowski 1874): in the Andes of northern and central Peru, excepting one relict population in the Department of Lima, Peru, on the western slopes of the central Peruvian Andes (Fjeldså & Krabbe 1990, Koepcke 1970), which could not be corroborated.

1.11.2. ***Coeligena violifer albicaudata*** Schuchmann & Züchner 1997: restricted to the Apurimac region, southern Peru.

1.11.3. ***Coeligena violifer osculans*** (Gould 1871): in the eastern Andes of south-east Peru (south-east of Urubamba), from the headwaters of the Rio Apurimac, central Peru, to the Cordillera de Carabaya on the border with Bolivia.

1.11.4. ***Coeligena violifer violifer*** (Gould 1846): in the Andes of north-west Bolivia, from the vicinity of La Paz, central Bolivia to Yungas near Cochabamaba, central Bolivia.

1.12. ***Coeligena iris*** (Gould, 1853): polytypic, ranges in a patchy way from southern Ecuador to central Peru, on both slopes of the Andes, altitude between 1700 –3400 m. It includes four subspecies:

1.12.1. ***Coeligena iris hesperus*** (Gould 1865): in the Cuenca region on the western slopes of the southern Ecuadorian Andes.

1.12.2. ***Coeligena iris iris*** (Gould 1853): from the Loja region in southern Ecuador to Taulis, on the western slopes of northern Peruvian Andes.

1.12.3. ***Coeligena iris fulgidiceps*** (Simon 1921): on the eastern bank of the River Marañon, in the Chachapoyas region, northwest Peru.

1.12.4. ***Coeligena iris eva*** (Salvin 1897): from the Taulis region to Cajamarca, in the northern Peruvian Andes.

1.13. ***Coeligena aurora*** (Gould 1853): monotypic, restricted to the Cutervo region, on the western bank of the River Marañon, northern Peru.

1.14. ***Coeligena insectivora*** (Tschudi 1844): polytypic, ranges from the eastern bank of the River Marañon, near Chachapoyas, in northern Peru, to the eastern bank of

River Apurimac, on the Vilcabamba mountain range, southern Peru. It includes three subspecies:

1.14.1 ***Coeligena insectivora margarethae*** (Zimmer 1948): from the vicinity of Chachapoyas to San Martin, on the eastern bank of the River Marañon, in northern Peru.

1.14.2 ***Coeligena insectivora insectivora*** (Tschudi 1844): from the headwaters of the River Marañon, on the Carpish mountain range, on the eastern slope of the central Peruvian Andes to Ayacucho, on the western bank of the River Apurimac in southern Peru.

1.14.3. ***Coeligena insectivora eisenmannii*** (Weske 1985): restricted to the Vilcabamba mountain range, southern Peru.

1.15. ***Coeligena inca*** (Gould 1852): polytypic, ranges from north-east of Cuzco, in southern Peru, to the Bolivian Yungas, Cordillera Cochabamba range, in northern Bolivia, in altitude between 1650 – 3300 m. It includes two subspecies:

1.15.1. ***Coeligena inca omissa*** (Zimmer 1948): from the vicinity of Cuzco to north-west of Lake Titicaca, in southern Peru, near the border with Bolivia.

1.15.2. ***Coeligena inca inca*** (Gould 1852): from south of Lake Titicaca, in the Cordillera Real range, to the Bolivian Yungas, Cordillera Cochabamba range, in northern Bolivia.

1.16. ***Coeligena cyanopterus*** (Fraser 1840): ranging from the Central Andes of Columbia, on both banks of the River Magdalena, to Cochabamba, northern Bolivia, occurring on both slopes of the Ecuadorian and north Peruvian Andes, altitude between 2800 – 4600 m. It includes three subspecies:

1.16.1. ***Coeligena cyanopterus caeruleus*** Zimmer 1951: from the Tolima region in the Central Andes of Colombia to Nariño, near the headwaters of the river Cauca and northern Ecuador.

1.16.2. ***Coeligena cyanopterus cyanopterus*** (Fraser 1849): from the surroundings of Bogotá, in the East Andes of Colombia, to the headwaters of the River Cauca, south-west Colombia.

1.16.3. ***Coeligena cyanopterus peruvianus*** (Boucard 1895): from northern Ecuador, near the border with Colombia, to north-east Bolivia, on both slopes of the Ecuadorian and Peruvian Andes.

1.17. ***Coeligena ensifera*** (Boissonneau 1839): monotypic, ranging from the Merida region, in the western Andes of Venezuela, to southern Peru, found on both banks of the River Magdalena, near the headwaters of the River Cauca, and on both slopes of the Ecuadorian and Peruvian Andes.

2. Genus ***Patagona*** Gray 1840: monotypic.

2.1. ***Patagona gigas*** (Vieillot 1834): polytypic, ranges from northern Ecuador to north-west Argentina, and separately from southern Peru to central-west Chile, found at an altitude ranging from 0 to above 3500 m. It includes two subspecies.

2.1.1. ***Patagona gigas peruviana*** (Boucard 1895) from the surroundings of Pichincha Volcano, on the western slopes of the Ecuadorian Andes, to the vicinity of La Paz, northern Bolivia.

2.1.2. ***Patagona gigas gigas*** (Vieillot 1834): from Cochabamba, near the Lake Poopo, in northern Bolivia, to Mendoza, in central-west Argentina (summer quarters) and from Arequipa, south-west Peru, to Villa del Mar, along the coast of Chile.

Summary

In this study the taxonomy, phylogeny, and biogeography of the Andean hummingbird genera *Coeligena* Lesson, 1832, *Pterophanes* Gould, 1849, *Ensifera* Lesson, 1843, and *Patagona* Gray, 1840 is analysed and reconstructed. Geographic variation in the study taxa was determined based on external characters, such as plumage coloration patterns and morphometric parameters. On this basis, taxonomic modifications were proposed.

The study material consisted of museum specimens deposited in international ornithological collections. Once the taxomony was clarified, a phylogenetic reconstruction was carried out. For this purpose, a matrix with the coloration characters of all the species was constructed. The phylogenetic relationships were reconstructed using the method of succesive character weighting. For the analysis the software PAUP* was employed.

The dependence of the phylogeny of the taxa on the geological history of their geographic ranges was tested, in this case the speciation and radiation scenarios and the uplift progression of the Andes. Vicariance processes were assumed to be the main factors modelling the speciation events within the taxa studied. To test this hypothesis, a Brook's Parsimony Analysis (BPA) was performed. The BPA analysis was based on the phylogenetic reconstruction obtained in this study. A biogeographic hypothesis applicable to other related Andean taxa is proposed.

The taxomomic conclusions of this study are:

- The genus *Coeligena* includes 17 species, and of these species, three were newly promoted to the category: *C. conradii*, *C. insectivora* (formerly considered subspecies of *C. torquata*), and *C. aurora* (formerly considered a subspecies of *C. iris*). The species included in the monotypic genera *Pterophanes* and *Ensifera* are now included in *Coeligena*: *Coeligena cyanopterus* and *Coeligena ensifera*.

- The subspecies *C. iris flagrans* is not considered valid, and is probably a product of intergradation between the subspecies *C. iris iris* and *C. iris eva*.

The geographic ranges of *Coeligena* and *Patagona* species and subspecies were corrected and in some cases extended.

The phylogenetic conclusions are:

- *Coeligena* is a monophyletic group with *Heliodoxa* as sister group, evidence not being found for the inclusion of *Patagona* within this clade. *Coeligena* subdivided very early into two main clades: one including the *torquata*-like species with the remainding species as sister group. This division reveals a parallel speciation process within the genus. *C. ensifera* and *C. cyanopterus* belong to the non-*torquata* sister group, showing strong relationships within *Coeligena* clades, confirming their close phylogenetic relatedness. These relationships need to be confirmed by means of further studies based on evidence other than plumage coloration.

- Within the non-*torquata* forms, two subdivision are distinguishable: one including the least sexually dimorphic species of *Coeligena* and the other including the extremely dimorphic forms. The low-altitude monomorphic northern *coeligena*-like species are grouped into one separate clade.

The biogeographic conclusions are:

- An early origin is proposed for the *Coeligena* species (Miocene) and, like other Andean taxa, their radiation and speciation responded to the progressive uplifting of the Andes.

- The centre of origin for *Coeligena* is proposed as being located in southern Peru. The later dispersal and radiation followed the formation of the mountain range northwards and possibly southwards, considering the asymmetric orogenic history of the Andes.

- The separation of ancestral populations by vicariance events promoted the speciation and differentiation of the extant taxa. The last uplift of the northern Andes, and the subsequent Pleistocene climatological changes, influenced and still influence the finer subdivision and isolation of the population,s thus promoting the formation of new taxa.

Zusammenfassung

In der vorliegenden Arbeit wurden Taxonomie, Phylogenie und Biogeographie der andinen Kolibrigattungen *Coeligena* Lesson 1832, *Pterophanes* Gould 1849, *Ensifera* Lesson 1843 und *Patagona* Gray 1840 analysiert und rekonstruiert. Geographische Variationen der untersuchten Arten wurden basierend auf externen Merkmalen wie Gefiederfärbungs-mustern und morphometrischen Parametern bestimmt. Auf dieser Grundlage wurden taxonomische Änderungen vorgeschlagen. Das Untersuchungsmaterial bestand aus Museumsbälgen aus internationalen ornithologischen Sammlungen. Nach Klärung der Taxonomie wurde eine phylogenetische Rekonstruktion durchgeführt. Zu diesem Zweck wurde eine Matrix mit den Farbmerkmalen aller Arten erstellt. Die phylogenetischen Beziehungen wurden mit Hilfe sukzessiver Merkmalsgewichtung rekonstruiert. Für die Analyse wurde die Software PAUP* verwendet. Die Abhängigkeit der Phylogenie der Taxa von der geologischen Geschichte ihres Verbreitungsgebietes wurde getestet, in diesem Fall die Speziations- und Radiationsszenarien und der Hebungsvorgang der Anden. Vikarianzprozesse wurden als Hauptfaktoren für die Speziationsereignisse innerhalb der untersuchten Arten angenommen. Um diese Hypothese zu überprüfen, wurde eine Parsimonie-Analyse nach Brooks (Brook's Parsimony Analysis, BPA) durchgeführt. Die BPA-Analyse basiert auf der phylogenetischen Rekonstruktion, die aus dieser Arbeit resultierte. Eine biogeographische Hypothese, die auch auf verwandte andinische Taxa zutrifft, wird vorgeschlagen.

Die taxonomischen Schlussfolgerungen dieser Arbeit lauten:

- Die Gattung *Coeligena* enthält 17 Arten, von denen drei neu zu diesem Taxon gerechnet werden: *C. conradii, C. insectivora* (bisher Unterart von *C. torquata*) und *C. aurora* (bisher Unterart von *C. iris*). Die Arten der monotypischen Gattungen *Pterophanes* und *Ensifera* werden nun in die Gattung *Coeligena* gestellt: *Coeligena cyanopterus* und *Coeligena ensifera*.
- Die Unterart *C. iris flagrans* wird als ungültig betrachtet und ist vermutlich ein Produkt der Intergradation zwischen den Unterarten *C. iris iris* und *C. iris eva*.

Die Verbreitungsgebiete der Arten und Unterarten der Gattungen *Coeligena* und *Patagona* wurden korrigiert und in einigen Fällen erweitert.

Die phylogenetischen Schlussfolgerungen lauten:

- *Coeligena* ist eine monophyletische Gruppe mit *Heliodoxa* als Schwestergruppe, Beweise für das Einschließen von *Patagona* in diese Gruppe wurden nicht gefunden. *Coeligena*

trennte sich sehr früh in zwei Hauptkladen: Die eine enthält die *torquata*-ähnlichen Arten, die andere die übrigen Arten als Schwestergruppe. Diese Einteilung offenbart einen parallelen Speziationsprozess innerhalb der Gattung. *C. ensifera* und *C. cyanopterus* gehören nicht zur *torquata*-Gruppe, sie zeigen starke Beziehungen innerhalb der *Coeligena*-Gruppe und bestätigen ihre enge phylogenetische Verwandtschaft. Diese Beziehungen müssen durch weitere Untersuchungen gestützt werden, die auf anderen Merkmalen als Gefiederfärbung beruhen.

- Innerhalb der Nicht-*torquata*-Gruppe sind zwei Untereinheiten unterscheidbar: Die eine enthält die am geringsten geschlechtsdimorphen Arten von *Coeligena*, die andere die extrem dimorphen Formen. Die monomorphen, nördlichen, *coeligena*-ähnlichen Arten, die in niedrigen Gebirgslagen vorkommen werden in einer getrennten Klade gruppiert.

Die biogeographischen Schlussfolgerungen lauten:

- Eine früher Ursprung der *Coeligena*-Arten wird vermutet (Miozän) und ihre Radiation und Speziation wie bei anderen andinischen Taxa als Antwort auf die voranschreitende Hebung der Anden gesehen.
- Das südliche Peru wird als Entstehungszentrum von *Coeligena* vorgeschlagen. Die spätere Dispersion und Radiation folgte der Formation der Gebirgsketten nordwärts und möglicherweise südwärts in Anbetracht der asymmetrischen orogenetischen Geschichte der Anden.
- Die Trennung ursprünglicher Populationen durch Vikarianzereignisse unterstützte die Speziation und Differenziation der vorhandenen Taxa. Die letzte Hebung der nördlichen Anden und die folgenden pleistozänen Klimaveränderungen beeinflussten und beeinflussen noch die feinere Unterteilung und Isolation der Populationen, durch die die Entstehung neuer Taxa gefördert wird.

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Acknowledgements

During the almost five year spent elaborating this work, I had the opportunity to meet many people, interesting people, to whom I own a lot and to whom I'm thankful.

First of all I want to thank my advisor, Dr. K.-L. Schuchmann for offering me the opportunity to make my dissertation in his research group at the Museum Alexander Koenig in Bonn.

I would like to thank the Deutsche Akademische Austauschdienst (DAAD) people, responsible for the FGMA-DAAD student-credits program: Dr. E. Schmidt, Frau Schede and Frau Metje. Thanks to their efficiency I did not starve!

I would like to give special thanks to Dr. Renate van den Elzen (Frau vdE). Frau van den Elzen, without your help in the right times I would not finish my work on time!

Thanks to the people in the Ornithologie, 2nd floor of the ZFMK! Thanks to Stefanie (a) Frau Rick and Katrin (a) Lady Shy for the good times, the company, and the trust in the hard times.

I also want to thank the people from the many collections visited, or to those that kindly sent loaned specimens for my use: Miguel Lentino, Colección Ornitológica Phelps in Caracas; Irma Franke, Museo Javier Prado in Lima; Gerald Mayr, Senckenberg Museum in Frankfurt am Main; Géraldine Veron, Muséum d'Histoire Naturelle in Paris; Mark Adams, Natural History Museum in Tring; George Barrowclough and Paul Sweet, American Museum of Natural History, New York; David Willard, Field Museum in Chicago; Alison Pirie, Museum of Comparative Zoology in Boston; Gary Grave, James Dean, National Museum of Natural History in Washington, D.C.; Leo Joseph and Nathan Rice, Academy of Natural Science in Philadelphia.

I want to thank all those who kindly received me, hosted me or found a place for me during the traveling along the World: Kent and Damon, Larry, Flia. Valdés-Velásquez, Milena, Gaby, Fabian.

Thanks to my collegues and friends that are, or were in the AG: Armando, Angela, Swen for time and patience in hearing my problems and helping me not to lose my head.

And now comes the hard part... To thank the people I loves and to whom I own what I am and will be...

I want to thank my parents, my two brothers, my three sisters, and their descesdent, for their inconditional support at the beginning (when I decide to leave my country and try out the life here in Europe), and during these past years. I am obliged to thank Mr. Grahan Bell for the wonderful invention called telephon!

Thank you Elena M. for everything!

I want to say thank all those that I do not mention but will never forget!

Thank you Frank! For saving my life, for giving me a home, for giving sense to my life and being my steady rock.

Danke viel Mals!

APPENDIX

Figure 1. Species of the genus *Coeligena* LESSON 1832. Plates courtesy of D. Alker.

Coeligena coeligena

Coeligena wilsoni

Coeligena prunellei

*Coeligena iris (*left female, right male)

Coeligena aurora

Coeligena violifer (left female, right male)

Figure 1 (Continued). Species of the genus *Coeligena* LESSON 1832. Plates courtesy of D. Alker.

Coeligena phalerata
(left male, right female)

Coeligena helianthea
(left male, right female)

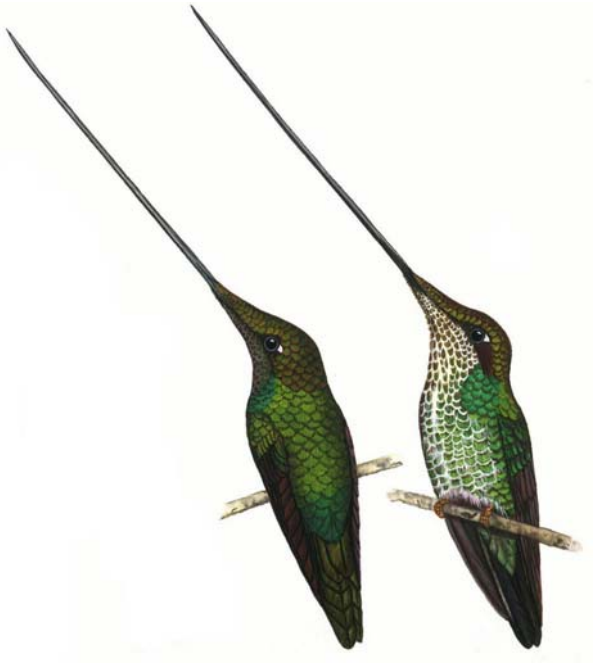
Coeligena (=*Pterophanes*) *cyanopterus*
(left female, right male)

Coeligena bonapartei
(male)

Coeligena eos
(left female, right male)

Figure 1 (Continued). Species of the genus *Coeligena* LESSON 1832. Plates courtesy of D. Alker.

Coeligena lutetiae
(left female, right male)



Coeligena (=*Ensifera*) *ensifera*
(left male, right female)

Coeligena inca
(right female, left male)

Coeligena torquata
(right female, left male)

Coeligena conradii (above male, below female)

Figure 2. The monotypic genus *Patagona* GRAY 1840. Female of *Patagona gigas* is at the left side of the figure; the male at the right side. Plates courtesy of D. Alker.

Table 1. Comparison between classifications proposed for *Coeligena* species and subspecies by Peter (1945), Schuchmann (1999), and this study.

Original Description	**Peters 1945**	**Schuchmann 1999**	**This Study**
Helianthea cœligena ferruginea Chapman, 1917	*Coeligena coeligena ferruginea* (Chapman)	*Coeligena coeligena ferruginea* (Chapman)	*Coeligena coeligena ferruginea* (Chapman)
Lampropygia columbiana Elliot, 1876	*Coeligena coeligena columbiana* (Elliot)	*Coeligena coeligena columbiana* (Elliot)	*Coeligena coeligena columbiana* (Elliot)
Lampropygia Boliviana Gould, 1861	*Coeligena coeligena boliviana* (Gould)	*Coeligena coeligena boliviana* (Gould)	*Coeligena coeligena boliviana* (Gould)
Lampropygia columbiana obscura Berlepsch & Stoltzmann, 1902	Not valid	*Coeligena coeligena obscura* (Berlepsch & Stoltzmann)	*Coeligena coeligena obscura* (Berlepsch & Stoltzmann)
Ornismya coeligena Lesson, 1832	*Coeligena coeligena coeligena* (Lesson)	*Coeligena coeligena coeligena* (Lesson)	*Coeligena coeligena coeligena* (Lesson)
Coeligena coeligena zuliana Phelps & Phelps, Jr., 1953	-	*Coeligena coeligena zuliana* Phelps & Phelps, Jr., 1953	*Coeligena coeligena zuliana* Phelps & Phelps, Jr., 1953
Coeligena coeligena zuloagae Phelps & Phelps, Jr., 1959	-	*Coeligena coeligena zuloagae* Phelps & Phelps, Jr., 1959	Not valid
Trochilus Wilsoni DeLattre & Bourcier, 1846	*Coeligena wilsoni* (DeLattre & Bourcier)	*Coeligena wilsoni* (DeLattre & Bourcier)	*Coeligena wilsoni wilsoni*(DeLattre & Bourcier)
-	-	-	*Coeligena wilsoni* ssp. nov.
Trochilus prunellei Bourcier 1843	*Coeligena prunellei* (Bourcier)	*Coeligena prunellei* (Bourcier)	*Coeligena prunellei* (Bourcier)
Ornismia torquata Boissonneau, 1840	*Coeligena torquata torquata* (Boissonneau)	*Coeligena torquata torquata* (Boissonneau)	*Coeligena* [*torquata*] *torquata torquata* (Boissonneau)
Bourcieria fulgidigula Gould, 1854	*Coeligena torquata fulgidigula* (Gould)	*Coeligena torquata fulgidigula* (Gould)	*Coeligena* [*torquata*] *torquata fulgidigula* (Gould)
Trochilus insectivorus Tschudi, 1844	*Coeligena torquata insectivorus* (Tschudi)	*Coeligena torquata insectivorus* (Tschudi)	*Coeligena* [*torquata*] *insectivorus insectivorus* (Tschudi)
Coeligena torquata margarethae Zimmer, 1948	*Coeligena torquata margarethae* Zimmer, 1948	*Coeligena torquata margarethae* Zimmer	*Coeligena* [*torquata*] *inscetivora margarethae* (Zimmer)
Coeligena torquata einsenmannii Weske, 1985	*Coeligena torquata einsenmannii* Weske	*Coeligena torquata einsenmannii* Weske	*Coeligena* [torquata] *insectivora einsenmannii* (Weske)
Trochilus conradii Bourcier, 1847	*Coeligena torquata conradii* (Bourcier)	*Coeligena torquata conradii* (Bourcier)	*Coeligena* [torquata] *conradii* (Bourcier)
Bourcieria inca Gould, 1852	*Coeligena* (*torquata*?) *inca*	*Coeligena inca inca* (Gould)	*Coeligena* [*torquata*] *inca inca*

Original Description	Peters 1945	Schuchmann 1999	This Study
	(Gould)		(Gould)
Coeligena torquata omissa Zimmer 1948	-	*Coeligena inca omissa* (Zimmer)	*Coeligena* [*torquata*] *inca omissa* (Zimmer)
Leucuria phalerata Bangs, 1898	*Coeligena phalerata* (Bangs)	*Coeligena phalerata* (Bangs)	*Coeligena phalerata* (Bangs)
Helianthea Eos Gould, 1848	*Coeligena eos* (Gould)	*Coeligena eos* (Gould)	*Coeligena* [*bonapartei*] *eos* (Gould)
Ornismia bonarpartei [sic] Boissonneau, 1840	*Coeligena bonapartei* (Boissonneau)	*Coeligena bonapartei* (Boissonneau)	*Coeligena* [*bonapartei*] *bonapartei* (Boissonneau)
Coeligena bonapartei consita Wetmore & Phelps, 1952	-	*Coeligena bonapartei consita* Wetmore & Phelps, 1952	*Coeligena bonapartei consita* Wetmore & Phelps, 1952
Coeligena orina Wetmore, 1953	-	*Coeligena bonapartei orina* (Wetmore)	*Coeligena bonapartei orina* (Wetmore)
Trochilus Lutetiæ DeLattre & Bourcier, 1846	*Coeligena lutetiae* (DeLattre & Bourcier)	*Coeligena lutetiae* (DeLattre & Bourcier)	*Coeligena* [*bonapartei*] *lutetiae lutetiae* (DeLattre & Bourcier)
Coeligena lutetiae ssp. nov.	-	-	*Coeligena* [*bonapartei*] *lutetiae* ssp. nov. (DeLattre & Bourcier)
Ornismya helianthea Lesson, 1838	*Coeligena helianthea* (Lesson)	*Coeligena helianthea helianthea* (Lesson)	*Coeligena helianthea helianthea* (Lesson)
Coeligena helianthea tamai Berlioz & Phelps, 1953	-	*Coeligena helianthea tamai* Berlioz & Phelps, 1953	*Coeligena helianthea tamai* Berlioz & Phelps, 1953
Helianthea dichroura Taczanowski, 1874	*Coeligena violifer dichroura* (Taczanowski)	*Coeligena violifer dichroura* (Taczanowski)	*Coeligena violifer dichroura* (Taczanowski)
Helianthea osculans Gould, 1871	*Coeligena violifer osculans* (Gould)	*Coeligena violifer osculans* (Gould)	*Coeligena violifer osculans* (Gould)
Trochilus (____?) *violifer* Gould, 1846	*Coeligena violifer violifer* (Gould)	*Coeligena violifer violifer* (Gould)	*Coeligena violifer violifer* (Gould)
Coeligena violifer albicaudata Schuchmann & Züchner, 1997	-	*Coeligena violifer albicaudata* Schuchmann & Züchner, 1997	*Coeligena violifer albicaudata* Schuchmann & Züchner, 1997
Helianthea Iris Gould, 1853	*Coeligena iris iris* (Gould)	*Coeligena iris iris* (Gould)	*Coeligena iris iris* (Gould)
Diphlogæna Hesperus Gould, 1865	*Coeligena iris hesperus* (Gould)	*Coeligena iris hesperus* (Gould)	*Coeligena iris hesperus* (Gould)
Diphlogæena Iris fulgidiceps Simon, 1921	?*Coeligena iris fulgidiceps* (Simon)	*Coeligena iris fulgidiceps* (Simon)	*Coeligena iris fulgidiceps* (Simon)
Diphlogæna Iris hypocrita Simon, 1921	?*Coeligena iris hypocrita* (Simon)	Not valid	Not valid
Diphlogæna eva Salvin, 1897	*Coeligena iris eva* (Salvin)	*Coeligena iris eva* (Salvin)	*Coeligena iris eva* (Salvin)
Coeligena iris flagrans Zimmer, 1951	-	*Coeligena iris flagrans* Zimmer,	Not valid

Original Description	**Peters 1945**	**Schuchmann 1999**	**This Study**
		1951	
Helianthea Aurora Gould, 1853	*Coeligena iris aurora* (Gould)	*Coeligena iris aurora* (Gould)	*Coeligena aurora* (Gould)
Ornismya ensifera Boissonneau, 1839	*Ensifera ensifera ensifera* (Boissonneau)	*Ensifera ensifera ensifera* (Boissonneau)	*Coeligena ensifera* (Boissonneau)
Docimaster ensiferus cærulescens W. P. Lowe	?*Ensifera ensifera caerulescens* (W.P. Lowe)	Not valid	Not valid
Ornismya Temminckii Boissonneua, 1839 *Trochilus cyanopterus*, Fraser, 1840	*Pterophanes cyanopterus cyanopterus* (Fraser)	*Pterophanes cyanopterus cyanopterus* (Fraser)	*Coeligena cyanoptera cyanoptera* (Fraser)
Pterophanes peruvianus Boucard, 1895	*Pterophanes cyanopterus peruvianus* (Boucard)	*Pterophanes cyanopterus peruvianus* (Boucard)	*Coeligena cyanoptera peruviana* (Boucard)
Patagona peruviana Boucard, 1895	*Patagona gigas peruviana* (Boucard)	*Patagona gigas peruviana* (Boucard)	*Patagona gigas peruviana* (Boucard)
Trochilus gigas Vieillot, 1824	*Patagona gigas gigas* (Vieillot)	*Patagona gigas gigas* (Vieillot)	*Patagona gigas gigas* (Vieillot)

Table 2. List of characters and the character states used for the phylogenetic analysis with PAUP*.

Character	Character states
[1] 'crown-males'	complete (0), frontal spot (1), central spot (2), absent (3)
[2] 'crown colour-males'	blue (0), like the head (1), green (2), violet (3), green-orange (4)
[3] 'crown hue-males'	no hue (0), bluish (1), yellowish (2)
[4] 'head pattern-males'	dull colouration (0), is the crown (1)
[5] 'head colour-males'	green (0), brown (1), black (2)
[6] 'head hue-males'	yellowish (0), blackish (1), bronze-reddish (2), greenish (3), no hue (4)
[7] 'nape-males'	green and brown (0), black (1), black and blue (2), green (3), brown (4)
[8] 'nape hue'	yellowish (0)', blackish (1), bluish (2), greenish-reddish (3), no hue (4)
[9] 'upper back main colour-males'	green (0), brown (1), black (2)
[10] 'upper back hue-males'	yellowish (0), reddish (1), bluish (2), no hue (3)
[11] 'upper back extra colour-males'	none (0), turquoise (1), golden-yellow (2), brown (3)
[12] 'lower back main colour-males'	green (0), black (1), blue (2), orange (3), brown (4)
[13] 'lower back hue-males'	yellowish-golden (0), bluish (1), greenish (2), reddish (3), no hue (4)
[14] 'lower back extra colour-males'	none (0), turquoise (1), green (2), white (3)
[15] 'upper tail-coverts colour-males'	green (0), blue (1), orange (2), brown (3), white (4)
[16] 'upper tail-coverts hue-males'	yellowish (0), greenish (1), purplish (2), reddish (3), no hue (4)
[17] 'chin pattern-males'	uniform (0), with discs and/or borders (1), two coloured (3)
[18] 'chin glittering-males'	dull (0), metallic (1)
[19] 'chin main colour-males'	white (0), blue (1), green (2), black (3)
[20] 'chin hue-males'	yellowish (0), greenish (1), reddish (2), bluish (3), greyish (4), no hue (5)
[21] 'throat form-males'	like the chin (0), different (1)
[22] 'throat pattern-male'	uniform (0), with discs an/or borders (2), central collar or band (3), central glittering patch (3)
[23] 'throat glittering-males'	dull (0), glittering (1)
[24] 'throat main colour'	white (0), green (1), blue (2), violet (3), brown (4)
[25] 'throat hue-males'	greyish (0), reddish (1), greenish (2), yellowish (3), bluish (4), no hue (5)
[26] 'throat extra colour-males'	green (0), blue (1), violet (2), brown (3), none (4)
[27] 'chest-males'	like the throat (0), different (1)
[28] 'chest pattern-males'	uniform (0), with discs and/or borders (1), whith lateral patches (2), white band (3)
[29] 'chest main colour-males'	green (0), black (1), white (2)
[30] 'chest hue-males'	green (0), black (1), white (2), none (3), bluish (4)
[31] 'belly-males'	like chest (0), different (1)
[32] 'belly pattern-males'	uniform (0), with discs or borders (1)
[33] 'belly main colour-males'	green (0), white (1), black (2), brown (3), orange (4)
[34] 'belly hue-males'	yellowish (0), violet (1), blackish (2), bluish (3), greenish (4)
[35] 'belly extra colour-males'	none (0), white (1), brown (2), green (3), black (4)
[36] 'under tail-coverts pattern-males'	one colour (0), with borders (1)
[37] 'under tail-coverts main colour-males'	green (0), brown (1), violet (2), white (3)
[38] 'under tail-coverts hue-males'	yellowish (0), greyish (1), reddish (2), bluish (3), none (4)
[39] 'under tail-coverts borders-males'	brown (0), white (1), none (2)
[40] 'tail pattern-males'	innermost rectrix different (0), all rectrices alike (2), outermost rectrix different (3)
[41] 'rectrices pattern'	not tipped (0), bilobblulated pattern (1), tipped (2)
[42] 'rectrices main colour-males'	black (0), brown (1), green (2), white (3)
[43] 'rectrices hue-males'	bluish (0), yellowish (1), greyish (2), reddish (3), violet (4), none (5)
[44] 'rectrices extra colour-males'	green (0), white (1), none (2)
[45] 'wings-coverts pattern-males'	all alike (0), blue and brown (1), yellowish brown and dark brown (2)
[46] 'remiges-males'	dark brown (0), tipped white (1), blue and dark brown (2), yellowish

Character	Character states
	brown and dark brown (3)
[47] 'crown-females'	absent (0), scaly pattern (1), frontal spot (2)
[48] 'back-females'	overall alike(0), lower back different (1), upper back different (2)
[49] 'head pattern-females'	uniform (0), with discs or borders (1)
[50] 'crown colour-females'	absent (0), green (1), green to orange blue (2)
[51] 'head colour-females'	green (0), black (1), brown (2)
[52] 'head hue-females'	yellowish (0), blackish (1), bluish (2), reddish (3), greenish (4), none (5)
[53] 'nape colour-females'	green (0), black (1), brown (2)
[54] 'nape hue-females'	yellowish (0), blackish (1), reddish (2), bluish (3), none (4)
[55] 'nape pattern-females'	like the head (0), different (1)
[56] 'upper back pattern-females '	like the nape (0), different (1)
[57] 'upper back colour-females'	green (0), black (1), brown (2)
[58] 'upper back hue-females'	none (0), yellowish (1), bluish (2), reddish-bronze (3)
[59] 'lower back pattern-females'	uniform (0), tipped or with borders (1)
[60] 'metallic lower back-females'	dull (0), glittering (1)
[61] 'lower back main colour-females'	green (0), black (1), blue (2), orange (3), brown (4)
[62] 'lower back hue-females'	yellowish (0), bluish (1), reddish (2), none (3)
[63] 'lower back extra colour-females'	none (0), green (1), white (2)
[64] 'upper tail-coverts pattern-females'	like lower back (0), different (1)
[65] 'upper tail-coverts main colour-females'	green (0), blue (1), orange (2), brown (3)
[66] 'upper tail-coverts hue-females'	yellowish (0), bluish (1), reddish (2), greenish (3), purplish (4), none (5)
[67] 'chin pattern-females'	with discs (0), uniform with sides different (1), with tips or borders (2), uniform (3)
[68] 'chin main colour-females'	white (0), brown (1), green (2), black (3)
[69] 'chin hue-females'	none (0), yellowish (1), bluish (2), greyish (3), reddish (4), brownish (5)
[70] 'chin extra colour-females'	green (0), brown (1), none (2)
[71] 'throat pattern-females'	like chin (0), with a central collar (1), with metallic colour (2), with two white lateral patches (3)
[72] 'throat main colour-females'	white (0), brown (1), black (2), green (3)
[73] 'throat hue-females'	none (0), yellowish (1), brownish (2), greyish (3), reddish (4)
[74] 'throat extra colour-females'	green (0), blue (1), violet (2), none (3)
[75] 'chest pattern-females'	with discs (0), uniform (1), with tips or borders (2), medially different (3), mottled with other colour (4)
[76] 'chest main colour-females'	white (0), green (1), brown (2), black (3)
[77] 'chest hue-females'	none (0), greyish (1), yellowish (2), bluish (3), reddish (4)
[78] 'chest extra colour-females'	green (0), brown (1), white (2), black (3), none (4)
[79] 'belly pattern-females'	different than the chest (0), like the chest (2)
[80] 'belly ornament-females'	with discs (0), borders different (1), uniform (2), mottled with other colour (3), medially different (4)
[81] 'belly main colour-females'	brown (0), white (1), green (2), orange (3), black (4)
[82] 'belly hue-females'	yellowish (0), bluish (1), blackish (2), none (3), reddish (4)
[83] 'belly extra colour-females'	green (0), white (1), brown (2), black (3), violet (4)
[84] 'under tail-coverts-females'	different than the belly (0), like the belly (1)
[85] 'under tail-coverts pattern-females'	uniform (0), with borders (1), the centre is different (2)
[86] 'under tail-coverts main colour-females'	green (0), brown (1)
[87] 'under tail-coverts hue-females'	yellowish (0), bluish (1), reddish (2), none (3)
[88] 'under tail-coverts extra colour-females'	none (0), brown (1), white (2), green (3)
[89] 'tail pattern-females'	inner rectrix different (0), with tips or borders (1), outermost rectrix border different (2), inner rectrix uniform, outer with bilobulated pattern (3), all alike (4)
[90] 'tail main colour-females'	green (0), white (1), brown (2)

Character	Character states
[91] 'tail hue-females'	gone (0), bluish (1), yellowish (2), reddish (3), blackish (4)
[92] 'tail extra colour-females'	brown (0), white (1), green (2), none (3)
[93] 'wings-coverts pattern-females'	like the upper back (0), upper coverts blue, rest fuscous olive (1), greyish olive + cinnamon (2), all blue (3)
[94] 'remiges pattern-females'	uniform (0), secondaries different (1), with tips or borders different (2)
[95] 'remiges colour-females'	dark brown (0), dark brown and white (1), dark brown and pale yellowish brown (2), dark brown and pale reddish brown (3)
[96] 'bill curvature'	curved (0), straight (1)
[97] 'curvature direction'	downward (0), upward (1), no curved (2)
[98] 'base of the bill'	wide (0), narrow (1)
[99] 'bill compression'	dorsoventral (0), lateral (1)

Table 4. Mean differences in wing-length (matrix upper half) and bill-length (lower half) between males of *Coeligena* species.
The numbers in bold represent mean differences with p<0.05 after Tuckey-Test. The 'y' and 'x' represent the substraction direction.

y

(x-y)

x

	C. coeligena	*C. phalerata*	*C. conradii*	*C. torquata*	*C. bonapartei*	*C. eos*	*C. helianthea*	*C. prunellei*	*C. lutetiae*	*C. wilsoni*	*C. violifer*	*C. iris*	*C. aurora*	*C. insectivora*	*C. inca*	*C. cyanopterus*	*C. ensifera*	*Patagona gigas*
C. coeligena		-0,7	-3,4	**-4,2**	1,2	-1,3	0,9	-3,8	-3,2	2,7	**-4,4**	**-8,1**	-4,1	-3,8	-2,6	**-30,6**	**4,4**	**54,5**
C. phalerata	1,5		-2,7	-3,5	2,0	-2,0	1,7	-3,1	-2,5	3,4	-3,6	-7,4	-3,4	-3,1	-1,8	**-29,8**	**3,6**	**53,7**
C. conradii	**-2,4**	**-3,9**		-0,8	4,7	**-4,7**	4,4	-0,4	0,2	6,1	-0,9	-4,7	-0,7	-0,4	0,8	**-27,1**	0,9	**51,1**
C. torquata	**-3,4**	**-4,9**	-0,9		5,5	**-5,5**	5,2	0,4	1,0	**6,9**	-0,1	-3,9	0,1	0,4	1,7	**-26,3**	0,1	**50,2**
C. bonapartei	0,3	-1,2	**2,7**	**3,7**		0,0	-0,3	-5,0	-4,5	1,4	-5,6	**-9,4**	-5,3	-5,1	-3,8	**-31,8**	**5,6**	**55,7**
C. eos	0,6	2,1	-1,8	**-2,8**	0,9		-0,4	-5,1	**-4,5**	1,4	**-5,6**	**-9,4**	**-5,4**	**-5,1**	**-3,9**	**-31,8**	**-5,6**	**55,8**
C. helianthea	0,1	-1,4	**2,5**	**3,5**	-0,2	0,7		-4,7	-4,2	1,7	-5,3	**-9,0**	-5,0	-4,8	-3,5	**-31,5**	**5,3**	**55,4**
C. prunellei	**2,9**	1,4	**5,4**	**6,3**	2,6	3,5	2,8		0,6	6,5	-0,5	-4,3	-0,3	0,0	1,2	**-26,7**	0,5	**50,7**
C. lutetiae	**-3,8**	**-5,3**	**-1,3**	-0,4	**-4,1**	**-3,2**	**-3,9**	**-6,7**		**5,9**	-1,1	**-4,9**	-0,9	-0,6	0,6	**-27,3**	1,1	**51,3**
C. wilsoni	0,1	-1,4	**2,5**	**3,4**	-0,2	0,7	0,0	-2,9	**3,9**		**-7,0**	**-10,8**	-6,8	-6,5	-5,3	**-33,2**	**7,0**	**57,2**
C. violifer	**-4,0**	**-5,5**	**-1,5**	-0,6	**-4,3**	**-3,4**	**-4,1**	**-6,9**	-0,2	**-4,0**		-3,8	0,3	0,5	1,8	**-26,2**	0,0	**50,1**
C. iris	0,1	-1,4	**2,5**	**3,5**	-0,2	0,7	0,0	-2,9	**3,9**	0,0	**4,1**		4,0	4,3	5,5	**-22,4**	**-3,8**	**46,4**
C. aurora	0,9	-0,6	**3,3**	**4,2**	0,6	1,5	0,8	-2,1	**4,7**	0,8	**4,8**	0,8		0,3	1,5	**-26,5**	0,3	**50,4**
C. insectivora	**-3,6**	**-5,1**	-1,2	-0,2	**-3,9**	**-3,0**	**-3,7**	**-6,5**	0,2	**-3,7**	0,4	**-3,7**	**-4,5**		1,2	**-26,7**	0,5	**50,7**
C. inca	**-3,2**	**-4,8**	-0,8	0,1	-3,6	-2,7	**-3,4**	**-6,2**	0,5	**-3,3**	0,7	**-3,3**	**-4,1**	0,3		**-28,0**	1,8	**51,9**
C. cyanopterus	**-1,5**	**-3,0**	0,9	**1,9**	-1,8	-0,9	-1,6	**-4,4**	**2,3**	**-1,6**	**2,5**	**-1,6**	**-2,4**	**2,1**	**1,7**		**-26,2**	**23,9**
C. ensifera	**63,2**	**64,7**	**60,8**	**59,8**	**-63,5**	**-62,6**	**63,3**	**66,2**	**59,4**	**63,3**	**59,2**	**63,3**	**64,1**	**59,6**	**60,0**	**61,7**		**50,1**
Patagona gigas	**7,5**	**9,1**	**5,1**	**4,2**	**7,9**	**-7,0**	**7,6**	**10,5**	**3,8**	**7,6**	**3,6**	**7,6**	**8,4**	**4,0**	**4,3**	**6,0**	**-55,7**	

Table 5. Mean differences in tail-length (matrix upper half) and tail fork-depth (lower half) between males of *Coeligena* species. The numbers in bold represent mean differences with $p<0.05$ after Tuckey-Test. The 'y' and 'x' represent the substraction direction.

y

(y-x)

(x-y)

x

	C. coeligena	*C. phalerata*	*C. conradii*	*C. torquata*	*C. bonapartei*	*C. eos*	*C. helianthea*	*C. prunellei*	*C. lutetiae*	*C. wilsoni*	*C. violifer*	*C. iris*	*C. aurora*	*C. insectivora*	*C. inca*	*C. cyanopterus*	*C. ensifera*	*Patagona gigas*
C. coeligena		**-0,7**	**3,0**	**5,3**	1,9	**-3,7**	1,3	-1,7	**2,4**	**4,9**	**2,6**	**-5,7**	**-3,4**	**4,6**	**5,6**	**-7,7**	**13,8**	**5,7**
C. phalerata	**0,0**		3,6	**6,0**	2,5	-4,4	2,0	-1,0	3,0	**5,6**	3,3	**-5,1**	-2,7	**5,3**	**6,2**	**-7,1**	**13,2**	**5,0**
C. conradii	3,5	3,5		2,4	-1,1	-0,8	-1,7	-4,6	-0,6	2,0	-0,4	**-8,7**	**-6,4**	1,7	2,6	**-10,7**	**16,8**	**8,7**
C. torquata	1,3	1,3	-2,2		-3,4	1,6	**-4,0**	**-7,0**	**-2,9**	-0,4	**-2,7**	**-11,0**	**-8,7**	-0,7	0,2	**-13,1**	**19,1**	**11,0**
C. bonapartei	2,6	2,6	-0,9	1,3		-1,8	-0,6	-3,6	0,5	3,0	0,7	**-7,6**	**-5,3**	2,7	3,7	**-9,6**	**15,7**	**7,6**
C. eos	**-4,3**	**-4,3**	-0,8	**-3,0**	-1,7		-2,4	-5,4	-1,4	1,2	-1,1	**-9,5**	**-7,1**	0,9	1,8	**-11,5**	**-17,6**	**9,4**
C. helianthea	3,3	3,3	-0,2	2,0	0,7	-1,0		-3,0	1,1	3,6	1,3	**-7,0**	**-4,7**	3,3	**4,3**	**-9,1**	**15,1**	**7,0**
C. prunellei	-2,3	-2,3	-5,8	-3,6	-4,9	**-6,6**	-5,6		4,1	**6,6**	4,3	-4,0	-1,7	**6,3**	**7,3**	**-6,1**	**12,1**	4,0
C. lutetiae	2,8	2,8	-0,7	1,5	0,2	-1,5	-0,5	5,1		2,5	0,2	**-8,1**	**-5,8**	2,2	**3,2**	**-10,1**	**16,2**	**8,1**
C. wilsoni	**5,5**	5,5	2,0	**4,2**	2,9	1,2	2,2	7,8	2,7		-2,3	**-10,6**	**-8,3**	-0,3	0,7	**-12,7**	**18,7**	**10,6**
C. violifer	-2,4	-2,4	**-5,9**	**-3,7**	-5,0	**-6,7**	**-5,7**	-0,1	**-5,2**	**-7,9**		**-8,3**	**-6,0**	2,0	3,0	**-10,3**	**16,4**	**8,3**
C. iris	**-6,3**	**-6,3**	**-9,8**	**-7,6**	**-8,9**	**-10,6**	**-9,6**	-4,0	**-9,1**	**-11,8**	**-3,9**		2,3	**10,3**	**11,3**	-2,0	**8,1**	0,0
C. aurora	-2,4	-2,4	**-5,8**	-3,7	-4,9	**-6,6**	-5,6	0,0	**-5,1**	**-7,8**	0,1	3,9		**8,0**	**9,0**	**-4,4**	**10,4**	2,3
C. insectivora	0,7	0,7	-2,8	-0,6	-1,9	**-3,6**	-2,6	3,0	-2,1	-4,8	3,1	**7,0**	3,0		1,0	**-12,4**	**18,4**	**10,3**
C. inca	1,7	1,7	-1,8	0,4	-0,9	-2,6	-1,6	4,0	-1,1	-3,8	4,1	**8,0**	4,1	1,0		**-13,3**	**19,4**	**11,3**
C. cyanopterus	**-19,5**	**-19,5**	**-23,0**	**-20,8**	**-22,1**	**-23,8**	**-22,8**	**-17,2**	**-22,3**	**-25,0**	**-17,1**	**-13,2**	**-17,1**	**-20,2**	**-21,2**		**6,1**	-2,0
C. ensifera	**9,4**	**9,4**	**12,9**	**10,7**	**12,0**	**-13,7**	**12,7**	**7,1**	**12,2**	**14,9**	**7,0**	**3,1**	**7,1**	**10,1**	**11,1**	**-10,1**		**-8,1**
Patagona gigas	**31,6**	**31,6**	**35,1**	**32,9**	**34,2**	**35,9**	**34,9**	**29,3**	**34,4**	**37,1**	**29,2**	**25,3**	**29,3**	**32,3**	**33,3**	**12,1**	**22,2**	

Table 6. Mean differences in wing-length (matrix upper half) and bill-length (lower half) between females of *Coeligena* species. The numbers in bold represent mean differences with $p<0.05$ after Tuckey-Test. The 'y' and 'x' represent the substraction direction.

y

(x-y)

x

	C. coeligena	*C. phalerata*	*C. conradii*	*C. torquata*	*C. bonapartei*	*C. eos*	*C. helianthea*	*C. prunellei*	*C. lutetiae*	*C. wilsoni*	*C. violifer*	*C. iris*	*C. aurora*	*C. insectivora*	*C. inca*	*C. cyanopterus*	*C. ensifera*	*Patagona gigas*
C. coeligena		0,0	-1,7	**-3,1**	-1,7	0,8	0,5	**-5,4**	**-3,0**	1,9	**-2,8**	**-7,3**	**-5,1**	**-3,6**	-2,0	**-34,2**	**7,6**	**58,0**
C. phalerata	**-1,6**		-1,7	**-3,0**	-1,7	0,9	0,6	**-5,3**	**-3,0**	2,0	**-2,8**	**-7,3**	**-5,0**	**-3,6**	-1,9	**-34,1**	**7,5**	**57,9**
C. conradii	**-3,8**	**-2,1**		-1,3	0,0	2,6	2,2	**-3,6**	-1,3	**3,6**	-1,1	**-5,6**	**-3,4**	-1,9	-0,3	**-32,5**	**5,9**	**56,2**
C. torquata	**-4,9**	**-3,3**	-1,1		1,3	**3,9**	**3,6**	-2,3	0,0	**5,0**	0,2	**-4,3**	-2,0	-0,6	1,1	**-31,1**	**4,5**	**54,9**
C. bonapartei	**-3,3**	-1,7	0,4	1,6		2,5	2,2	-3,6	-1,3	3,6	-1,1	**-5,6**	-3,4	-1,9	-0,3	**-32,5**	**5,9**	**56,3**
C. eos	**-4,5**	**-2,9**	-0,8	0,4	-1,2		-0,3	**-6,2**	**-3,9**	1,1	**-3,7**	**-8,2**	**-5,9**	**-4,5**	-2,8	**-35,0**	**8,4**	**58,8**
C. helianthea	**-2,8**	-1,2	0,9	2,1	0,5	1,7		**-5,9**	**-3,5**	1,4	**-3,3**	**-7,8**	**-5,6**	**-4,1**	-2,5	**-34,7**	**8,1**	**58,5**
C. prunellei	**2,3**	**3,9**	**6,0**	**7,2**	**5,6**	**6,8**	**5,1**		2,3	**7,3**	2,5	-2,0	0,3	1,7	3,4	**-28,8**	2,2	**52,6**
C. lutetiae	**-5,9**	**-4,3**	**-2,2**	-1,0	**-2,6**	-1,4	**-3,1**	**-8,2**		**5,0**	0,2	**-4,3**	-2,1	-0,6	1,0	**-31,2**	**4,6**	**54,9**
C. wilsoni	-1,2	0,5	**2,6**	**3,8**	2,2	**3,4**	1,7	**-3,4**	**4,8**		**-4,8**	**-9,3**	**-7,0**	**-5,5**	**-3,9**	**-36,1**	**9,5**	**59,9**
C. violifer	**-6,4**	**-4,8**	**-2,7**	**-1,5**	**-3,1**	-1,9	**-3,6**	**-8,7**	-0,5	**-5,3**		**-4,5**	-2,2	-0,8	0,8	**-31,4**	**4,8**	**55,1**
C. iris	**-2,7**	-1,1	1,1	**2,2**	0,6	1,8	0,1	**-5,0**	**3,2**	**-1,6**	**3,7**		2,2	**3,7**	**5,3**	**-26,9**	0,3	**50,6**
C. aurora	**-1,9**	-0,3	1,8	**3,0**	1,4	2,6	0,9	**-4,2**	**4,0**	-0,8	**4,5**	0,8		1,5	3,1	**-29,1**	2,5	**52,9**
C. insectivora	**-6,2**	**-4,6**	**-2,5**	-1,3	**-2,9**	-1,7	**-3,4**	**-8,5**	-0,3	**-5,1**	0,2	**-3,5**	**-4,3**		1,6	**-30,6**	**4,0**	**54,3**
C. inca	**-4,5**	**-2,9**	-0,7	0,4	-1,2	0,1	-1,6	**-6,8**	1,5	**-3,3**	**1,9**	-1,8	**-2,5**	1,8		**-32,2**	**5,6**	**56,0**
C. cyanopterus	-1,2	0,4	2,6	**3,7**	2,1	**3,4**	1,7	**-3,5**	**4,7**	0,0	**5,2**	**1,5**	0,8	**5,1**	**3,3**		**-26,6**	**23,8**
C. ensifera	**70,6**	**68,9**	**66,8**	**65,6**	**67,2**	**66,0**	**67,7**	**72,8**	**64,6**	**69,4**	**64,1**	**67,8**	**68,6**	**64,3**	**66,1**	**69,4**		**50,4**
Patagona gigas	**7,5**	**5,8**	**3,7**	**2,6**	**4,1**	2,9	**4,6**	**9,8**	1,5	**6,3**	1,0	**4,8**	**5,5**	1,2	**3,0**	**6,3**	**-63,1**	

Table 7. Mean differences in tail-length (matrix upper half) and tail fork-length (lower half) between females of *Coeligena* species. The numbers in bold represent mean differences with $p<0.05$ after Tuckey-Test. The 'y' and 'x' represent the substraction direction.

y

(y-x)

(x-y)

x

	C. coeligena	***C. phalerata***	***C. conradii***	***C. torquata***	***C. bonapartei***	***C. eos***	***C. helianthea***	***C. prunellei***	***C. lutetiae***	***C. wilsoni***	***C. violifer***	***C. iris***	***C. aurora***	***C. insectivora***	***C. inca***	***C. cyanopterus***	***C. ensifera***	***Patagona gigas***
C. coeligena		0,7	**2,6**	**4,6**	0,8	2,6	1,3	**-3,0**	-0,6	**4,1**	**2,2**	**-4,1**	**-2,4**	**3,7**	**4,7**	**-9,7**	**8,8**	**8,8**
C. phalerata	0,8		1,9	**3,9**	0,1	1,9	0,6	**-3,7**	-1,3	**3,4**	1,5	**-4,8**	**-3,1**	**3,0**	**4,0**	**-10,4**	**9,5**	**9,5**
C. conradii	**2,5**	1,7		2,0	-1,8	0,0	-1,3	**-5,6**	**-3,2**	1,5	-0,4	**-6,7**	**-5,0**	1,1	2,1	**-12,3**	**11,4**	**11,4**
C. torquata	1,1	0,4	-1,4		**-3,8**	-1,9	**-3,3**	**-7,5**	**-5,2**	-0,5	**-2,4**	**-8,7**	**-7,0**	-0,9	0,2	**-14,3**	**13,4**	**13,3**
C. bonapartei	-1,0	-1,8	**-3,5**	-2,2		1,8	0,5	-3,8	-1,4	3,3	1,4	**-4,9**	-3,2	2,9	3,9	**-10,5**	**9,6**	**9,6**
C. eos	1,1	0,3	-1,4	0,0	2,1		-1,4	**-5,6**	-3,3	1,5	-0,4	**-6,8**	**-5,1**	1,0	2,1	**-12,3**	**11,4**	**11,4**
C. helianthea	1,8	1,0	-0,7	0,7	2,8	0,7		**-4,3**	-1,9	2,8	0,9	**-5,4**	**-3,7**	2,4	**3,4**	**-11,0**	**10,1**	**10,1**
C. prunellei	**-4,3**	**-5,1**	**-6,8**	**-5,4**	-3,3	**-5,4**	**-6,1**		2,3	**7,1**	**5,2**	-1,2	0,5	**6,7**	**7,7**	**-6,7**	**5,8**	**5,8**
C. lutetiae	-0,5	-1,3	**-3,0**	**-1,6**	0,5	-1,6	-2,3	**3,8**		**4,7**	**2,8**	**-3,5**	-1,8	**4,3**	**5,3**	**-9,1**	**8,2**	**8,1**
C. wilsoni	**4,5**	**3,7**	2,0	**3,4**	**5,5**	**3,4**	2,7	**8,8**	5,0		-1,9	**-8,2**	**-6,5**	-0,4	0,6	**-13,8**	**12,9**	**12,9**
C. violifer	**-2,2**	**-2,9**	**-4,7**	**-3,3**	-1,1	**-3,3**	**-3,9**	2,1	-1,6	**-6,6**		**-6,3**	**-4,6**	1,5	2,5	**-11,9**	**11,0**	**11,0**
C. iris	**-6,0**	**-6,8**	**-8,5**	**-7,1**	**-5,0**	**-7,1**	**-7,8**	-1,7	**-5,5**	**-10,5**	**-3,8**		1,7	**7,8**	**8,8**	**-5,6**	**4,7**	**4,6**
C. aurora	**-2,5**	**-3,3**	**-5,0**	**-3,7**	-1,5	**-3,6**	**-4,3**	1,8	-2,0	**-7,0**	-0,4	**3,5**		**6,1**	**7,1**	**-7,3**	**6,4**	**6,3**
C. insectivora	0,1	-0,7	-2,4	-1,0	1,1	-1,0	-1,7	**4,4**	0,6	**-4,4**	2,3	**6,1**	2,6		1,0	**-13,4**	**12,5**	**12,5**
C. inca	0,8	0,0	-1,7	-0,3	1,8	-0,3	-1,0	**5,1**	1,3	**-3,7**	**2,9**	**6,8**	3,3	0,7		**-14,4**	**13,5**	**13,5**
C. cyanopterus	**-24,7**	**-25,4**	**-27,1**	**-25,8**	**-23,6**	**-25,7**	**-26,4**	**-20,3**	**-24,1**	**-29,1**	**-22,5**	**-18,7**	**-22,1**	**-24,7**	**-25,4**		-0,9	-0,9
C. ensifera	**9,1**	**9,9**	**11,6**	**10,2**	**8,1**	**10,2**	**10,9**	**4,8**	**8,6**	**13,6**	**6,9**	**3,1**	**6,6**	**9,2**	**9,9**	**-15,5**		0,0
Patagona gigas	**37**	**37,74**	**39,47**	**38,11**	**35,94**	**38,07**	**38,77**	**32,67**	**36,46**	**41,46**	**34,82**	**30,98**	**34,45**	**37,07**	**37,76**	**12,33**	**27,87**	

Table 8. List of the revised specimens of *Coeligena bonapartei*

SUBSPECIES	POOLS	sex	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
consita	Perija	f	nmnh	372902	Camp above Hiroca (S of South Teta) Sierra de Perija	1800	Colombia	37,6	38,5	44,3	5,80	73,2
consita	Perija	f	ansp	72752	Campamento Frontera 2, Sierra Perijá, Zulia	3000	Venezuela	39,7	37,7	46,1	8,40	71,8
consita	Perija	f	cop	72752	Campamento Frontera 2, Sierra Perijá, Zulia	3000	Venezuela	39,7	37,7	46,1	8,40	71,8
consita	Perija	f	ansp	54416	Cerro Tetari, Perija, Zulia	2900	Venezuela	40,6	36,6	43,9	7,30	74,1
consita	Perija	f	cop	54416	Cerro Tetari, Perija, Zulia	2900	Venezuela	40,6	36,6	43,9	7,30	74,1
consita	Perija	f	nmnh		Pie SE Cerro Tetari, Perijá, Zulia	2900	Venezuela	38,5	36,6	44,8	8,20	70,7
consita	Perija	m	cop	72751	Campamento Frontera 2, Sierra Perijá, Zulia	3000	Venezuela		39,2	50,4	11,20	78,6
bonapartei	Cundinamarca	m	amnh	121588	El Peñón (above Fusagasuga)	3150	Colombia	36,5		43,8		72,2
bonapartei	Cundinamarca	m	zfmk		La Dorada	2500	Colombia	34,7	34,9	44,8	9,90	74,4
orina	Frontino	m	nmnh	436219	Páramo Frontino, Antioquia	3890	Colombia	35,5	38,8	45,3	6,50	72,0
bonapartei	UNLOCATED	f	zfmk	8551	"Bogotá"			36,0	35,4	42,6	7,20	66,1
bonapartei	UNLOCATED	f	zfmk	8550	"Bogotá"			36,7	37,5	42,2	4,70	63,3
bonapartei	UNLOCATED	f	zfmk	8549	"Bogotá"			39,1	37,9	44,3	6,40	65,6
bonapartei	UNLOCATED	f	mhnp		"Colombia"			38,5	38,2	39,7	1,50	69,7
bonapartei	UNLOCATED	f	mhnp		"Colombia"				36,8	40,6	3,80	70,6
bonapartei	UNLOCATED	m	zfmk	8545	"Bogotá"			34,2	38,3	45,0	6,70	71,0
bonapartei	UNLOCATED	m	zfmk	8541	"Bogotá"			33,1	35,4	48,2	12,80	76,5
bonapartei	UNLOCATED	m	zfmk	8548	"Bogotá"			34,2	37,4	45,2	7,80	68,9
bonapartei	UNLOCATED	m	zfmk	8546	"Bogotá"			35,4	36,5	45,0	8,50	68,2
bonapartei	UNLOCATED	m	zfmk	8543	"Bogotá"			32,5	37,3	44,6	7,30	73,7
bonapartei	UNLOCATED	m	zfmk	8547	"Bogotá"			34,6	36,6	44,0	7,40	65,9
bonapartei	UNLOCATED	m	mhnp		"Colombia"			34,4	36,0	45,1	9,10	68,3
bonapartei	UNLOCATED	m	zfmk		"Colombia"			34,2	36,5	46,3	9,80	68,1
bonapartei	UNLOCATED	m	mhnp		"Colombia"			33,2	35,7	45,0	9,30	75,7
bonapartei	UNLOCATED	m	mhnp		"Colombia"			34,3	36,4	44,8	8,40	76,4
bonapartei	UNLOCATED	m	zfmk	8544				37,0	36,2	43,8	7,60	69,3
bonapartei	UNLOCATED	m	zfmk	8542				36,8	34,7	40,1	5,40	62,7

Table 9. List of the revised specimens of *Coeligena coeligena.*

SUBSPECIES	POOL	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
coeligena	Caripe	f	amnh	482989	Caripe, Anzoátegui	900	Venezuela	38,3	38,1	41,3	3,2	67,5
coeligena	Caripe	m	amnh	482896	Caripe, Anzoátegui	900	Venezuela		39,4	50,6	11,2	76,0
coeligena	Caripe	m	amnh	482897	Caripe, Anzoátegui	900	Venezuela	37,3	39,3	48,4	9,1	75,5
coeligena	Golfotriste	f	cop	19042	Cerro Golfo Triste, San Casimiro, Aragua	1100	Venezuela		37,0	41,1	4,1	66,7
coeligena	Golfotriste	f	cop	19043	Cerro Golfo Triste, San Casimiro, Aragua	1000	Venezuela	37,1				67,6
coeligena	Avila	f	amnh	482901	Caracas, Dto. Federal	917	Venezuela	36,4	36,0	43,3	7,3	69,7
coeligena	Avila	f	cop	62552	Sebucán, Cerro El Ávila	1600	Venezuela	38,1	36,6	45,2	8,6	69,3
coeligena	Avila	f	cop	62553	Cerro Papelón, Cerro Ávila	1900	Venezuela	36,6	36,1	43,8	7,7	69,1
coeligena	Avila	f	cop	62554	San Antonio de Galipán, Dto. Federal	1600	Venezuela	34,8	38,9	51,6	12,7	74,7
coeligena	Avila	f	nmw	5608	Galipán, Cerro del Avila	1600	Venezuela	36,9	36,9	41,7	4,8	70,2
coeligena	Avila	m	cop	7746	Curupao, Miranda	1200	Venezuela	36,7	38,6	51,9	13,3	77,5
coeligena	Avila	m	fmnh	45508	Caracas, Dto. Federal	917	Venezuela	37,4	34,2	43,4	9,2	72,0
coeligena	Avila	m	nmw	92340	Silla de Caracas, Miranda		Venezuela	35,5	39,6	51,1	11,5	74,9
coeligena	Aragua	f	cop	13366	Colonia Tovar, Aragua	1900	Venezuela	37,6	36,9	44,7	7,8	70,7
coeligena	Aragua	f	cop	13368	Colonia Tovar, Aragua	1200	Venezuela	37,1	38,1	53,4	15,3	77,0
coeligena	Aragua	m	cop	13367	Colonia Tovar, Aragua	1900	Venezuela	36,1		49,4		73,9
coeligena	Aragua	m	cop	56777	El Junquito, Caracas, Dto. Federal	2100	Venezuela	36,6	39,8	53,7	13,9	76,4
coeligena	Aragua	m	nmnh	575263	Pico Guacamayo, above Rancho Grande, Aragua	1800	Venezuela	36,2	37,3	51,5	14,2	76,9
coeligena	Aragua	m	nmnh	371493	Colonia Tovar, Aragua	1930	Venezuela	35,0	36,3	44,9	8,6	73,7
coeligena	Valencia	f	amnh	482895	Cumbre de Valencia, Carabobo	1700	Venezuela	37,1	36,2	41,0	4,8	68,7
coeligena	Valencia	f	amnh	482894	Cumbre de Valencia, Carabobo	1700	Venezuela	37,8	38,0	42,9	4,9	71,4
coeligena	Valencia	f	amnh	482894	Cumbre de Valencia, Carabobo	1700	Venezuela	39,8	38,4	46,4	8,0	73,4
coeligena	Valencia	f	nmw	92338	Cumbre de Valencia, Carabobo		Venezuela	39,4	38,3	41,8	3,5	73,5
coeligena	Valencia	f	nmw	92339	Cumbre de Valencia, Carabobo		Venezuela	38,7	36,5	43,4	6,9	71,6
coeligena	Yaracuy	f	cop	63926	Cerro El Candelo, Aroa, Yaracuy	1700	Venezuela	39,5	38,2	44,1	5,9	68,1
coeligena	Yaracuy	f	cop	63928	Cerro El Candelo, Aroa, Yaracuy	1500	Venezuela	40,4	37,8	44,5	6,7	
coeligena	Yaracuy	f	cop	63929	Cerro El Candelo, Aroa, Yaracuy	1700	Venezuela	38,9	35,4	43,2	7,8	69,3
coeligena	Yaracuy	f	cop	26734	Bucaral, Yaracuy	1300	Venezuela			43,0		69,8
columbiana	Lara	f	cop	8787	Cubiro, Lara	1900	Venezuela	32,8	37,3	44,2	6,9	65,7
columbiana	Lara	f	cop	5195	Cubiro, Lara	1800	Venezuela	35,5	35,2	44,6	9,4	63,8
columbiana	Lara	f	cop	71653	Las Trojas, 45 km S Cabudare, Lara	1500	Venezuela	33,5	35,6	41,4	5,8	67,3
columbiana	Lara	f	cop	72010	35 km S Cabudare, Lara	1400	Venezuela	33,5	35,5	42,5	7,0	67,5
columbiana	Lara	f	cop	71654	Las Trojas, 45 km S Cabudare, Lara	1500	Venezuela	36,6		43,4		67,1
columbiana	Lara	m	cop	71656	Las Trojas, 45 km S Cabudare, Lara	1500	Venezuela	33,9	36,1	46,3	10,2	70,6
columbiana	Lara	m	cop	76139	Terepaima, Lara	1250	Venezuela	33,9		49,8		72,9
zuliana	Perija	f	nmnh	372903	La Africa, Sierra Perijá, Magdalena	1900	Colombia	34,1				68,3
zuliana	Perija	f	nmnh	368798	Tierra Nueva, SE of Fonseca, Sierra Negra, Magdalena	1700	Colombia		35,9	43,8	7,9	69,2
zuliana	Perija	f	cop	57363	Cerro Avispa, Fila Macoíta y Apón, Perijá, Zulia	2175	Venezuela	34,2	36,8	42,3	5,5	63,2
zuliana	Perija	f	cop	54532	Cerro Pejochaina, cumbre, Perijá, Zulia	1800	Venezuela	31,5	32,4	38,9	6,5	63,5
zuliana	Perija	f	cop	54529	Cerro Pejochaina, cumbre, Perijá, Zulia	2300	Venezuela	32,5	34,1	40,8	6,7	
zuliana	Perija	f	cop	54530	Cerro Pejochaina, cumbre, Perijá, Zulia	1900	Venezuela	33,1	35,6	43,7	8,1	66,2

Table 9. List of the revised specimens of *Coeligena coeligena.*

SUBSPECIES	POOL	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
zuliana	Perija	m	nmnh	368799	Tierra Nueva, SE of Fonseca, Sierra Negra, Magdalena	1700	Colombia	32,0	37,9	52,0	14,1	73,6
zuliana	Perija	m	nmnh	368800	Monte Elias, SE of Fonseca, Sierra Negra, Magdalena	1700	Colombia	31,8	38,4	50,0	11,6	74,6
columbiana	Tachira	f	cop	62011	Hacienda La Providencia, Río Chiquito, Táchira	1800	Venezuela		36,9	37,3	0,4	65,2
columbiana	Tachira	f	cop	62007	Hacienda La Providencia, Río Chiquito, Táchira	2000	Venezuela	32,5	36,0	42,8	6,8	67,1
columbiana	Tachira	f	cop	62012	Hacienda La Providencia, Río Chiquito, Táchira	1800	Venezuela	33,8	33,7	40,9	7,2	65,6
columbiana	Tachira	f	cop	61108	Hacienda La Providencia, Río Chiquito, Táchira	1900	Venezuela	34,2	36,0	44,1	8,1	66,3
columbiana	Tachira	f	cop	61105	Hacienda La Providencia, Río Chiquito, Táchira	1800	Venezuela	32,8		38,1		65,0
columbiana	Tachira	f	cop	76719	Topo Gallinero, Palmira, Táchira	2200	Venezuela	33,1	37,6	44,0	6,4	70,4
columbiana	Tachira	f	cop	76718	Topo Gallinero, Palmira, Táchira	2000	Venezuela	36,2	36,7	44,2	7,5	72,5
columbiana	Tachira	m	nmnh	401595	Palo Gordo, 10 miles SE Villa Felisa-Tachira Valley, San	1520	Colombia		38,3	52,9	14,6	73,9
columbiana	Tachira	m	cop	61103	Hacienda La Providencia, Río Chiquito, Táchira	1800	Venezuela	34,8	39,0	48,5	9,5	71,3
columbiana	Tachira	m	cop	61106	Hacienda La Providencia, Río Chiquito, Táchira	1800	Venezuela	34,4	38,1	47,7	9,6	68,2
columbiana	Tachira	m	cop	62008	Hacienda La Providencia, Río Chiquito, Táchira	1800	Venezuela	35,8	36,9	47,8	10,9	65,3
columbiana	Tachira	m	cop	61107	Hacienda La Providencia, Río Chiquito, Táchira	1800	Venezuela	34,8	38,3	50,2	11,9	46,2
columbiana	Tachira	m	cop	62010	Hacienda La Providencia, Río Chiquito, Táchira	1800	Venezuela	34,9	37,5	49,7	12,2	73,9
columbiana	Tachira	m	cop	76717	Topo Gallinero, Palmira, Táchira	2200	Venezuela	35,8	38,5	50,7	12,2	76,6
columbiana	Tachira	m	cop	9377	Queniquea, Táchira	1600	Venezuela	35,1		51,8		75,3
columbiana	Santander	f	ansp	173576	Bucaramanga, Santander	1008	Colombia	35,6	37,6	41,8	4,2	66,3
columbiana	Santander	f	nmnh	392338	Buenos Aires, Santander N, Highway Ábrego (?)-Sardinata	1980	Colombia	32,3	36,5	43,9	7,4	66,3
columbiana	Santander	m	ansp	66653	Las Ventanas, Santander		Colombia	31,6	37,4	49,8	12,4	72,3
columbiana	Santander	m	nmnh	392340	Buenos Aires, Santander N, Highway Ábrego (?)-Sardinata	1980	Colombia	32,7	38,9	46,4	7,5	75,7
columbiana	Santander	m	nmnh	392339	Buenos Aires, Santander N, Highway Ábrego (?)-Sardinata	1980	Colombia	32,9	37,6	47,9	10,3	70,7
columbiana	Santander	m	nmnh	392336	Buenos Aires, Santander N, Highway Ábrego (?)-Sardinata	1980	Colombia	34,4	37,0	47,4	10,4	71,6
columbiana	Santander	m	nmnh	392337	Buenos Aires, Santander N, Highway Ábrego (?)-Sardinata	1980	Colombia	32,2	37,7	48,2	10,5	72,8
columbiana	Santander	m	nmnh	392333	Buenos Aires, Santander N, Highway Ábrego (?)-Sardinata	1980	Colombia	33,8	37,1	50,9	13,8	74,7
columbiana	Antioquia	f	cks	8916	Monte (Alto) Socorro, West Cordiller.	3500	Colombia	33,3	38,4	41,3	2,9	68,1
columbiana	Antioquia	f	cks	8915	Alto de las Cruces, West Cordiller.	2200	Colombia	33,9	35,5	39,7	4,2	66,3
columbiana	Antioquia	f	cks	8913	Alto de las Cruces, West Cordiller.	2200	Colombia	36,1	37,9	43,0	5,1	68,1
columbiana	Antioquia	f	cks	8912	Alto de las Cruces, West Cordiller.	2200	Colombia	33,4	35,7	43,6	7,9	64,6
columbiana	Antioquia	f	cks	8903	San Antonio, West Cordiller.	2100	Colombia	33,9	37,8	40,9	3,1	67,1
columbiana	Antioquia	f	cks	8910	San Antonio, West Cordiller.	2100	Colombia		35,9	45,6	9,7	69,3
columbiana	Antioquia	f	nmnh	425747	Hacienda Potreros, 15 miles SW Frontino, Río Herradura,	2000	Colombia	34,6	37,2	41,0	3,8	69,7
columbiana	Antioquia	f	nmnh	425748	Hacienda Potreros, 15 miles SW Frontino, Río Herradura,	2000	Colombia	35,6	36,4	41,7	5,3	67,8
columbiana	Antioquia	f	nmnh	425745	Hacienda Potreros, 15 miles SW Frontino, Río Herradura,	2000	Colombia	32,5	36,2	46,0	9,8	70,3
columbiana	Antioquia	m	cks	8906	San Antonio, West Cordiller	2100	Colombia		37,6	45,3	7,7	70,4
columbiana	Antioquia	m	cks	8904	San Antonio, West Cordiller	2100	Colombia	33,9	37,5	46,6	9,1	74,8
columbiana	Antioquia	m	cks	8908	San Antonio, West Cordiller	2100	Colombia	33,0	36,9	46,8	9,9	71,4
columbiana	Antioquia	m	cks	8909	San Antonio, West Cordiller	2100	Colombia	34,6	37,6	47,8	10,2	71,8
columbiana	Antioquia	m	cks	8905	San Antonio, West Cordiller	2100	Colombia	34,8	37,5	49,6	12,1	73,2
columbiana	Antioquia	m	mhnp		Antioquia	700	Colombia	34,3	38,2	47,6	9,4	73,2
columbiana	Antioquia	m	nmnh	425746	Hacienda Potreros, 15 miles SW Frontino, Río Herradura,	2000	Colombia	36,5	38,3	45,6	7,3	73,2

Table 9. List of the revised specimens of *Coeligena coeligena.*

SUBSPECIES	POOL	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
columbiana	Antioquia	m	nmnh	475744	Hacienda Potreros, 15 miles SW Frontino, Río Herradura,	2000	Colombia		37,4	46,3	8,9	72,0
columbiana	Antioquia	m	nmnh	401596	Valdivia, above Sevilla, Antioquia	1300	Colombia	34,2	36,5	46,8	10,3	72,6
columbiana	Moscopan	m	nmnh	436221	La Bodega, N side of Río Negrito, Antioquia	1750	Colombia	32,9	36,6	46,2	9,6	70,4
columbiana	Moscopan	m	nmnh	436220	La Bodega, N side Río Negrito, Antioquia	1750	Colombia	34,4	36,6	48,6	12,0	66,1
columbiana	Moscopan	m	nmnh	389272	Moscopan, Cauca	2000	Colombia	33,2		49,8		73,0
columbiana	Quindio1	f	cks	8901	Río Toche, Paso del Quindío	2100	Colombia	35,1	37,7	43,3	5,6	73,0
columbiana	Quindio1	f	cks	8899	Río Toche, Paso del Quindío	2100	Colombia	35,1	36,6	43,9	7,3	71,4
columbiana	Quindio1	m	amnh	111599	Salento, W. Quindio, Cauca	2100	Colombia	32,1	37,1	43,9	6,8	68,2
columbiana	Quindio1	m	cks	8900	Río Toche, Paso del Quindío.	2100	Colombia	35,0	37,5	46,8	9,3	73,7
columbiana	Quindio1	m	nmnh	255961	Salento, W. Quindío	2300	Colombia	34,0	36,4	47,0	10,6	73,2
columbiana	Quindio2	m	amnh	111591	Río Toche, E. Quindio,Tolima	2100	Colombia	34,7	39,0	47,0	8,0	73,9
columbiana	Quindio2	m	amnh	108821	Río Toche, E. Quindio,Tolima	2100	Colombia	35,7	40,0	49,3	9,3	72,4
columbiana	Quindio2	m	amnh	111602	El Edén, E. Quindio, Tolima	2700	Colombia		37,5	45,0	7,5	69,9
columbiana	Quindio2	m	amnh	111600	El Edén, E. Quindio, Tolima	2700	Colombia	35,4	36,4	45,5	9,1	69,2
columbiana	Quindio2	m	amnh	111601	El Edén, E. Quindio, Tolima	2700	Colombia	35,6	36,6	46,2	9,6	71,2
columbiana	Quindio2	m	nmnh	255962	Río Toche, E.Quindío, Tolima	2230	Colombia	36,0	36,4	46,8	10,4	73,6
columbiana	Cundinamarca	m	amnh	121599	Fusagasugá, Cundinamarca	1850	Colombia	33,0	38,9	45,2	6,3	73,2
columbiana	Cundinamarca	m	amnh	802381	Fusagasugá, Cundinamarca	1850	Colombia	34,1	38,0	50,1	12,1	75,8
columbiana	Cundinamarca	m	amnh	130651	Anolaima, Cundinamarca	1500	Colombia	34,5	36,7	49,6	12,9	73,6
columbiana	Cundinamarca	m	zfmk	84241	Bogotá	2590	Colombia	35,6		48,6		69,1
columbiana	Gamboa	f	amnh	482911	Las Cruces, Cauca	2200	Colombia	34,1	37,5	41,7	4,2	71,3
columbiana	Gamboa	f	amnh	482910	Las Cruces, Cauca	2200	Colombia		35,8	40,1	4,3	70,2
columbiana	Gamboa	f	amnh	107889	San Antonio [now Gamboa], Cauca	2300	Colombia	35,4	37,0	41,5	4,5	67,7
columbiana	Gamboa	f	nmnh	255960	San Antonio, Cauca	2160	Colombia	34,4		41,4		66,3
columbiana	Gamboa	f	zfmk	87025	Cali, n. Buenaventura	2100	Colombia	34,8	38,0	43,0	5,0	
columbiana	Gamboa	m	amnh	107845	San Antonio [now Gamboa], Cauca	2300	Colombia	32,7	36,9	45,2	8,3	73,9
columbiana	Gamboa	m	amnh	107843	San Antonio [now Gamboa], Cauca	2160	Colombia	34,3	38,2	48,1	9,9	74,9
columbiana	Gamboa	m	amnh	107849	San Antonio [now Gamboa], Cauca	2160	Colombia		37,2	47,6	10,4	72,5
columbiana	Gamboa	m	amnh	108820	San Antonio [now Gamboa], Cauca	2160	Colombia	33,3	37,8			74,3
columbiana	Gamboa	m	nmnh	225959	San Antonio, Cauca	2160	Colombia	34,9		49,6		73,4
columbiana	Gamboa	m	zfmk	87024	Cali, n. Buenaventura	2100	Colombia		37,2	41,6	4,4	71,7
columbiana	Popayan	f	amnh	109446	Cerro Munchique, W. of Popayán, Cauca	2730	Colombia	34,6	35,4	41,6	6,2	67,5
columbiana	Popayan	f	ansp	142570	Munchique, El Tambo, Cauca	1970	Colombia		35,4	45,6	10,2	67,7
columbiana	Popayan	f	fmnh	281977	Popayán, Cauca	1750	Colombia	33,9	37,5	44,7	7,2	72,4
columbiana	Popayan	f	fmnh	251262	Above Uribe, Cauca	2200	Colombia	33,7	37,0	41,9	4,9	69,4
columbiana	Popayan	f	nmnh	446081	Cerro Munchiquito, Cauca	2300	Colombia	33,6	39,1	39,8	0,7	65,9
columbiana	Popayan	f	nmnh	446070	Cerro Munchiquito, Cauca	2300	Colombia	34,3	37,2	40,9	3,7	69,0
columbiana	Popayan	f	nmnh	446083	Cerro Munchiquito, Cauca	2300	Colombia	34,2	36,1	41,9	5,8	66,5
columbiana	Popayan	m	amnh	109447	Cerro Munchique, W. of Popayán, Cauca	2730	Colombia	34,6	35,8	41,0	5,2	68,7
columbiana	Popayan	m	ansp	142568	Munchique, El Tambo, Cauca	1770	Colombia	33,0	37,9	47,3	9,4	75,0
columbiana	Popayan	m	ansp	142571	Munchique, El Tambo, Cauca	2000	Colombia	34,9	39,3	51,5	12,2	77,2

Table 9. List of the revised specimens of *Coeligena coeligena.*

SUBSPECIES	POOL	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
columbiana	Popayan	m	fmnh	281978	Popayán, Cauca	1750	Colombia	33,2	38,6	48,6	10,0	72,0
columbiana	Popayan	m	nmnh	446071	Cerro Munchiquito, Cauca	2300	Colombia	31,8	36,8	45,7	8,9	72,9
columbiana	Popayan	m	nmnh	446082	Cerro Munchiquito, Cauca	2300	Colombia	35,7	37,8	50,6	12,8	74,4
columbiana	Popayan	m	nmnh	446084	Hda. La Capilla, 20km N of Popayan, Cauca	2000	Colombia	33,5	40,3	52,5	12,2	76,1
columbiana	Huila	f	amnh	115910	Andalucía western slope, Huila	900	Colombia	36,1	36,6	40,9	4,3	64,9
columbiana	Huila	f	amnh	115911	Andalucía western slope, Huila	900	Colombia	35,0	36,2	41,3	5,1	68,3
columbiana	Huila	f	amnh	482913	Río Aguacatal, Huíla	1800	Colombia	32,6	35,5	43,0	7,5	66,3
columbiana	Huila	f	nmnh	446072	La Candela, 10 miles SW of San Agustín, Huila	2300	Colombia	35,0	36,3	41,7	5,4	69,8
columbiana	Huila	f	nmnh	446074	La Candela, 10 miles SW of San Agustín, Huila	2300	Colombia	35,2	35,4	42,3	6,9	65,6
columbiana	Huila	m	nmnh	446075	La Candela, 10 miles SW of San Agustín, Huila	2300	Colombia	36,2	39,5	51,9	12,4	76,1
columbiana	Huila	m	nmnh	446078	Belén, 45km SW of La Plata, Huila	2300	Colombia	33,9	38,2	38,8	0,6	73,1
columbiana	Huila	m	nmnh	446077	Belén, 45km SW of La Plata, Huila	2300	Colombia		37,5	50,4	12,9	74,3
columbiana	Mindo	m	nmnh	150780	Mindo, Quito	1264	Ecuador	36,2	38,0	45,0	7,0	69,9
columbiana	Baeza	f	amnh	185107	Sumaco Abajo; Napo		Ecuador	33,8	35,8	39,7	3,9	68,0
columbiana	Baeza	f	mhnp		Baeza		Ecuador	35,4	36,3	39,6	3,3	67,8
columbiana	Baeza	f	nmnh	173764	Baeza	1525	Ecuador	33,5	35,3	37,3	2,0	70,2
columbiana	Baeza	f	nmnh	173770	Baeza	1525	Ecuador	32,5	33,9	37,1	3,2	65,6
columbiana	Baeza	f	nmnh	173769	Baeza	1525	Ecuador	34,6	36,1	41,1	5,0	70,0
columbiana	Baeza	f	nmnh	173775	Baeza	1525	Ecuador	33,9	32,2	38,2	6,0	67,3
columbiana	Baeza	f	amnh	180056	Río Oyacachi Abajo, Chaco	2500	Ecuador	27,4	34,7	40,1	5,4	68,4
columbiana	Baeza	f	amnh	175949	Río Oyacachi Abajo, Chaco	2500	Ecuador	32,9	36,3	41,9	5,6	66,8
columbiana	Baeza	f	amnh	180059	Río Oyacachi Abajo, Chaco	2500	Ecuador	35,2	34,8	40,5	5,7	68,4
columbiana	Baeza	m	amnh	185106	Sumaco Abajo; Napo		Ecuador	34,4	36,7	44,8	8,1	71,9
columbiana	Baeza	m	amnh	185105	Sumaco Abajo; Napo		Ecuador	34,0	37,2	47,7	10,5	76,7
columbiana	Baeza	m	amnh	175946	Baeza Arriba, Napo	1525	Ecuador	33,9	37,5	47,2	9,7	72,1
columbiana	Baeza	m	amnh	175947	Río Oyacachi Abajo, Chaco	2500	Ecuador	35,2	39,8	41,3	1,5	67,2
columbiana	Baeza	m	amnh	180046	Río Oyacachi Abajo, Chaco	2500	Ecuador	35,0	40,2	43,4	3,2	71,6
columbiana	Baeza	m	amnh	175950	Río Oyacachi Abajo, Chaco	2500	Ecuador	35,3	37,6	43,5	5,9	72,3
columbiana	Baeza	m	amnh	180055	Río Oyacachi Abajo, Chaco	2500	Ecuador	34,6	36,7	43,9	7,2	71,6
columbiana	Baeza	m	amnh	180045	Río Oyacachi Abajo, Chaco	2500	Ecuador	36,3	38,7	46,8	8,1	73,4
columbiana	Baeza	m	amnh	180053	Río Oyacachi Abajo, Chaco	2500	Ecuador	34,8	35,9	44,4	8,5	75,0
columbiana	Baeza	m	amnh	175951	Río Oyacachi Abajo, Chaco	2500	Ecuador	35,3	38,2	47,1	8,9	74,2
columbiana	Baeza	m	amnh	180052	Río Oyacachi Abajo, Chaco	2500	Ecuador	32,9	36,1	45,6	9,5	72,9
columbiana	Baeza	m	amnh	180043	Río Oyacachi Abajo, Chaco	2500	Ecuador	36,6	37,0	47,0	10,0	71,3
columbiana	Baeza	m	amnh	180044	Río Oyacachi Abajo, Chaco	2500	Ecuador	35,2	37,5	47,6	10,1	75,2
columbiana	Baeza	m	amnh	180050	Río Oyacachi Abajo, Chaco	2500	Ecuador	34,4	35,8	46,6	10,8	73,8
columbiana	Baeza	m	amnh	184042	Río Oyacachi Abajo, Chaco	2500	Ecuador	35,5	37,0	50,3	13,3	77,2
columbiana	Baeza	m	amnh	180058	Puente del Río Quijos, Napo		Ecuador	35,5	38,0	47,8	9,8	73,8
columbiana	Baeza	m	nmnh	173772	Baeza	1525	Ecuador	35,9	33,8	43,0	9,2	71,2
columbiana	Baeza	m	nmnh	173768	Baeza	1525	Ecuador	34,5	38,8	48,4	9,6	75,4
columbiana	Baeza	m	nmnh	173766	Baeza	1525	Ecuador	35,7	38,0	50,0	12,0	74,5

Table 9. List of the revised specimens of *Coeligena coeligena.*

SUBSPECIES	POOL	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
columbiana	Baeza	m	nmnh	173759	Baeza	1525	Ecuador	34,6	37,0	49,5	12,5	77,1
columbiana	Tungurahua	f	amnh	482903	Hacienda Río Negro, Río Pastaza	1300	Ecuador	35,6	36,5	40,8	4,3	66,4
columbiana	Tungurahua	f	fmnh	372420	Baños, Tungurahua	2000	Ecuador	34,0	36,0	39,3	3,3	68,5
columbiana	Tungurahua	f	fmnh	99467	Mera, Río Pastaza, Pastaza	1140	Ecuador	35,3	36,4	40,2	3,8	68,8
columbiana	Tungurahua	f	mhnp		Huilca (West of Macas)	1225	Ecuador	35,4	37,0	41,6	4,6	67,9
columbiana	Tungurahua	m	ansp	176760	S. of trail from Logroño to Yaupi, W slope Cord. Del Cut	1975	Ecuador	36,4	38,0	48,4	10,4	75,2
columbiana	Tungurahua	m	ansp	176758	S. of trail from Logroño to Yaupi, W slope Cord. Del Cut	1975	Ecuador	38,0	38,1	49,4	11,3	76,4
columbiana	Tungurahua	m	ansp	176759	S. of trail from Logroño to Yaupi, W slope Cord. Del Cut	1975	Ecuador	36,4	39,1	52,4	13,3	74,3
columbiana	Condor	f	ansp	185221	Panguri, ca 12km NE San Francisco del Vergel, Zamora- Ch	1575	Ecuador	34,6	37,4	43,1	5,7	67,8
columbiana	Condor	f	ansp	185222	Panguri, ca 12km NE San Francisco del Vergel, Zamora- Ch	1600	Ecuador	38,1	35,6	41,9	6,3	69,3
columbiana	Condor	f	amnh	181215	Chaupe,Cajamarca	1860	Peru	37,6	37,4	42,0	4,6	69,4
columbiana	Condor	f	amnh	181214	Chaupe,Cajamarca	1860	Peru	35,1	39,8	50,6	10,8	77,3
columbiana	Condor	m	ansp	185220	Panguri, ca 12km NE San Francisco del Vergel, Zamora- Ch	1575	Ecuador	36,8	38,0	50,4	12,4	75,4
columbiana	Condor	m	ansp	183132	Above Chinapinza, Cordillera del Cóndor, Zamora- Chinchi	1700	Ecuador	36,1	37,1	46,0	8,9	71,1
columbiana	Condor	m	amnh	181213	Chaupe,Cajamarca	1860	Peru	35,3	37,8	48,3	10,5	75,1
obscura	Amazonas	m	musm	4662	Bagua Grande, Bosque Undina, Amazonas	1700	Peru	37,9	37,5	49,5	12,0	75,6
obscura	Amazonas	m	musm	5120	12 km E trail La Peca, Amazonas	2000	Peru	36,7	37,2	49,1	11,9	74,5
obscura	Utcubamba	f	amnh	169590	Chilpes, Junín	2225	Peru		37,2	42,6	5,4	66,5
obscura	Utcubamba	f	amnh	798871	7 km road NW Carpish Pass, Huánuco	2450	Peru	33,9	38,0	40,1	2,1	66,5
obscura	Utcubamba	f	amnh	821039	Cerros del Sira (at summit) , Huánuco	2220	Peru	36,8	38,8	41,4	2,6	69,5
obscura	Utcubamba	f	amnh	234398	Uscho, Chachapoyas, ab. 50 miles, Amazonas	1525	Peru	37,1	35,7	40,2	4,5	69,0
obscura	Utcubamba	f	musm	6398	ca. 9 km SSE Oxapampa, Sta. Cruz, Pasco	2050	Peru	37,9	35,5	42,4	6,9	68,1
obscura	Utcubamba	f	musm	6036	Trail to Hda. Paty, below Carpish Pass, Huánuco	2400	Peru	36,9	34,8	42,7	7,9	70,0
obscura	Utcubamba	f	musm	10084	Trail to Hda. Paty, below Carpish Pass, Huánuco	2470	Peru	37,2	35,2	45,6	10,4	67,5
obscura	Utcubamba	m	amnh	169589	Chilpes, Junín	2225	Peru	34,7	38,8	49,7	10,9	75,6
obscura	Utcubamba	m	amnh	169588	Chilpes, Junín	2225	Peru	37,2		50,9		73,0
obscura	Utcubamba	m	amnh	168985	Utcuyacu, Junín	1465	Peru	36,3	37,4	47,4	10,0	74,2
obscura	Utcubamba	m	amnh	234397	Uscho, Chachapoyas, ab. 50 miles, Amazonas	1525	Peru	35,1	39,8	50,6	10,8	77,3
obscura	Utcubamba	m	ansp	115563	Utcubamba, Libertad	1830	Peru	36,7	37,3	49,3	12,0	71,7
obscura	Utcubamba	m	ansp	115561	Rio Jelache, San Martin	1373	Peru		37,3	48,5	11,2	74,7
obscura	Utcubamba	m	musm	6316	ca. 9 km SSE Oxapampa, Sta. Cruz, Pasco	2050	Peru	38,5	37,8	50,0	12,2	75,1
obscura	Utcubamba	m	musm	6317	ca. 9 km SSE Oxapampa, Sta. Cruz, Pasco	2050	Peru	37,6	36,1	48,9	12,8	72,4
obscura	Utcubamba	m	musm	4846	Campang, above Utcubamba, on trail to Ongón, La Libertad	2250	Peru	37,5	38,2	53,2	15,0	77,2
obscura	Vilcabamba	f	amnh	145057	Idma, above Sta. Ana, Urubamba Valley, Cuzco	1524	Peru	37,8	36,5	45,3	8,8	69,3
obscura	Vilcabamba	f	amnh	820255	Cordillera Vilcabamba, Cuzco	1730	Peru	36,3	35,8	40,2	4,4	68,6
obscura	Vilcabamba	f	amnh	820385	Cordillera Vilcabamba, Cuzco	2100	Peru	36,6	35,5	40,5	5,0	70,4
obscura	Vilcabamba	f	musm	4984	Hda. Hugro, between Huayopata and Quillabamba, Cuzco	2000	Peru	37,2				68,8
obscura	Vilcabamba	m	amnh	145056	Idma, above Sta. Ana, Urubamba Valley, Cuzco	1524	Peru	36,7	37,6	49,6	12,0	73,5
obscura	Vilcabamba	m	amnh	819992	9 km E of Luisiana, Cordillera Vilcabamba, Ayacucho	1450	Peru	35,7	36,3	46,7	10,4	72,8
obscura	San Pedro	f	fmnh	364268	San Pedro village, Cuzco-Shintuya highway	1500	Peru	36,1	34,6	38,7	4,1	65,2
obscura	San Pedro	f	fmnh	320961	Cerro Pantiacolla, above Río Palotoa, Madre de Dios	1350	Peru	36,5	35,8	41,0	5,2	66,6

Table 9. List of the revised specimens of *Coeligena coeligena.*

SUBSPECIES	POOL	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
obscura	San Pedro	f	musm	13570	Cerro de Pantiacolla, above Río Palotoa	1075	Peru	35,5	35,0	49,2	14,2	67,1
obscura	San Pedro	m	fmnh	364269	San Pedro village, Cuzco-Shintuya highway	1500	Peru	36,8	36,0	45,6	9,6	71,5
obscura	San Pedro	m	fmnh	320962	Cerro Pantiacolla, above Río Palotoa, Madre de Dios	1350	Peru	38,9	37,7	44,3	6,6	73,9
obscura	San Pedro	m	fmnh	320960	Cerro Pantiacolla, above Río Palotoa, Madre de Dios	1350	Peru	37,7	38,1	49,2	11,1	76,8
obscura	La Paz	f	amnh	149867	Camp. No.1 Below Limbani, Puno		Peru	35,2	33,6	39,2	5,6	67,2
obscura	La Paz	f	amnh	149868	Camp. No.1 Below Limbani, Puno		Peru	37,5	33,2	39,7	6,5	66,6
obscura	La Paz	f	musm	6189	Abra de Maruncunca, 10 km SW San Juan del Oro, Puno	2000	Peru	36,9	35,1	41,0	5,9	
boliviana	Locotal	f	amnh	138680	Locotal, Cochabamba	1775	Bolivia	37,5	35,5	43,4	7,9	69,8
boliviana	Locotal	f	amnh	138679	Locotal, Cochabamba	1775	Bolivia		37,4	51,3	13,9	65,2

Table 10. List of the revised specimens of *Coeligena eos*

POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
Merida	m	nmnh	354747	Conejos, Mérida	3000	Venezuela	34,1	39,1	44,7	5,6	70,5
Merida	m	zfmk	8557	Mérida		Venezuela	35,1	34,7	44,6	9,9	71,8
Merida	m	fmnh	119956	Tambor, Mérida	3000	Venezuela	34,2	36,5	44,9	8,4	71,5
Merida	m	fmnh	296956	Tambor, Mérida	3000	Venezuela	35,5	35,1	46,1	11,0	72,3
Merida	m	fmnh	53526	Río Mucujún, Mérida	2950	Venezuela	35,6	35,7	43,9	8,2	74,3
Merida	m	fmnh	53525	Río Mucujún, Mérida	2950	Venezuela	38,9	38,2	42,4	4,2	71,0
Merida	m	amnh	482785	Los Duraznos, Mérida		Venezuela	34,2	37,0	44,9	7,9	73,1
Merida	m	nmnh	149154	Mérida		Venezuela		34,9	36,7	1,8	71,6
Merida	m	amnh	482782	Mérida, Mérida		Venezuela	35,9	37,5	45,9	8,4	73,1
Merida	m	amnh	182347	Nevados, near Mérida	3000	Venezuela	34,7	37,3	45,0	7,7	71,4
Merida	m	amnh	37532	Nevados, near Mérida		Venezuela	34,8	36,9	45,9	9,0	73,4
Merida	m	amnh	482791	Nevados, near Mérida		Venezuela	35,0	36,1			73,0
Merida	m	amnh	482789	Valle de Mérida		Venezuela	36,1	36,6	43,2	6,6	72,0
Merida	m	amnh	482787	Valle de Mérida		Venezuela	37,2	37,4	38,9	1,5	71,8
Merida	m	amnh	113510	Valle de Mérida		Venezuela	33,8	36,6	43,0	6,4	72,0
Merida	m	amnh	177188	Escorial, Mérida	3000	Venezuela	35,4	37,1	46,0	8,9	73,2
Merida	m	amnh	100522	Escorial, Mérida	3000	Venezuela		37,0	44,9	7,9	72,8
Merida	m	amnh	482780	Escorial, Mérida	2500	Venezuela	35,1				70,3
Merida	m	amnh	100523	Escorial, Mérida		Venezuela	35,0	37,4	44,9	7,5	73,1
Merida	m	zfmk	8556	El Escorial, Mérida	2500	Venezuela	34,0	37,5	46,3	8,8	70,0
Merida	m	zfmk	8555	El Escorial, Mérida	3000	Venezuela	36,5	36,8	43,5	6,7	72,6
Merida	m	zfmk	8559	El Escorial, Mérida	3000	Venezuela	38,8	41,9	40,4	-1,5	66,7
Merida	m	zfmk	8558	El Escorial, Mérida	3000	Venezuela	40,0	36,4	38,4	2,0	66,5
Merida	m	zfmk		El Loro, Mérida	4000	Venezuela	35,3		44,4		70,4
Merida	m	zfmk	8554	Culata, Mérida	3000	Venezuela	34,8		44,0		70,1
Merida	m	zfmk	8552	Culata, Mérida	4000	Venezuela	35,2	35,8	41,9	6,1	68,6
Merida	m	zfmk	8553	Culata, Mérida	4000	Venezuela	34,4	35,6	43,9	8,3	74,3
Merida	m	nmnh	190496	La Culata, Mérida	3000	Venezuela		34,4	36,4	2,0	73,8
Merida	m	fmnh	46182	Los Conejos, Mérida	3000	Venezuela	35,9	38,3	46,8	8,5	72,7
Merida	f	amnh	482786	Sierra de Mérida	3000	Venezuela	41,5	38,8	43,0	4,2	69,7
Merida	f	amnh	482788	Páramo del Morro, Mérida	3000	Venezuela	40,7	37,2	39,3	2,1	67,9
Merida	f	amnh	100524	Escorial, Mérida	3000	Venezuela	38,6	36,8	40,6	3,8	68,3
Merida	f	amnh	482781	Escorial, Mérida	3000	Venezuela	40,7	37,4	40,5	3,1	66,9
Merida	f	fmnh	199957	La Culata, Mérida	4400	Venezuela	40,0	36,5	40,6	4,1	65,7
Merida	f	amnh	482783	La Culata, Mérida		Venezuela	39,2	36,5			66,0
Merida	f	amnh	482784	La Culata, Mérida	4000	Venezuela	40,4	36,6	40,6	4,0	68,9
Merida	f	amnh	100526	Conejos, Mérida	3000	Venezuela	39,3	38,3	42,6	4,3	67,5
Tama	m	cop	22490	Boca de Monte, Pregonero, Táchira	2400	Venezuela	35,8	37,8	47,9	10,1	73,1
UNLOCATED	f	cop	49038	Mesa de Lino, Santo Domingo	2700	Venezuela		36,8	43,9	7,1	67,1
UNLOCATED	f	nmnh	437683	Cendé, Páramo Cendé, Trujillo	2700	Venezuela	38,9	36,1	38,7	2,6	67,9

Table 10. List of the revised specimens of *Coeligena eos*

POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
Merida	m	nmnh	354747	Conejos, Mérida	3000	Venezuela	34,1	39,1	44,7	5,6	70,5
Merida	m	zfmk	8557	Mérida		Venezuela	35,1	34,7	44,6	9,9	71,8
Merida	m	fmnh	119956	Tambor, Mérida	3000	Venezuela	34,2	36,5	44,9	8,4	71,5
Merida	m	fmnh	296956	Tambor, Mérida	3000	Venezuela	35,5	35,1	46,1	11,0	72,3
Merida	m	fmnh	53526	Río Mucujún, Mérida	2950	Venezuela	35,6	35,7	43,9	8,2	74,3
Merida	m	fmnh	53525	Río Mucujún, Mérida	2950	Venezuela	38,9	38,2	42,4	4,2	71,0
Merida	m	amnh	482785	Los Duraznos, Mérida		Venezuela	34,2	37,0	44,9	7,9	73,1
Merida	m	nmnh	149154	Mérida		Venezuela		34,9	36,7	1,8	71,6
Merida	m	amnh	482782	Mérida, Mérida		Venezuela	35,9	37,5	45,9	8,4	73,1
Merida	m	amnh	182347	Nevados, near Mérida	3000	Venezuela	34,7	37,3	45,0	7,7	71,4
Merida	m	amnh	37532	Nevados, near Mérida		Venezuela	34,8	36,9	45,9	9,0	73,4
Merida	m	amnh	482791	Nevados, near Mérida		Venezuela	35,0	36,1			73,0
Merida	m	amnh	482789	Valle de Mérida		Venezuela	36,1	36,6	43,2	6,6	72,0
Merida	m	amnh	482787	Valle de Mérida		Venezuela	37,2	37,4	38,9	1,5	71,8
Merida	m	amnh	113510	Valle de Mérida		Venezuela	33,8	36,6	43,0	6,4	72,0
Merida	m	amnh	177188	Escorial, Mérida	3000	Venezuela	35,4	37,1	46,0	8,9	73,2
Merida	m	amnh	100522	Escorial, Mérida	3000	Venezuela		37,0	44,9	7,9	72,8
Merida	m	amnh	482780	Escorial, Mérida	2500	Venezuela	35,1				70,3
Merida	m	amnh	100523	Escorial, Mérida		Venezuela	35,0	37,4	44,9	7,5	73,1
Merida	m	zfmk	8556	El Escorial, Mérida	2500	Venezuela	34,0	37,5	46,3	8,8	70,0
Merida	m	zfmk	8555	El Escorial, Mérida	3000	Venezuela	36,5	36,8	43,5	6,7	72,6
Merida	m	zfmk	8559	El Escorial, Mérida	3000	Venezuela	38,8	41,9	40,4	-1,5	66,7
Merida	m	zfmk	8558	El Escorial, Mérida	3000	Venezuela	40,0	36,4	38,4	2,0	66,5
Merida	m	zfmk		El Loro, Mérida	4000	Venezuela	35,3		44,4		70,4
Merida	m	zfmk	8554	Culata, Mérida	3000	Venezuela	34,8		44,0		70,1
Merida	m	zfmk	8552	Culata, Mérida	4000	Venezuela	35,2	35,8	41,9	6,1	68,6
Merida	m	zfmk	8553	Culata, Mérida	4000	Venezuela	34,4	35,6	43,9	8,3	74,3
Merida	m	nmnh	190496	La Culata, Mérida	3000	Venezuela		34,4	36,4	2,0	73,8
Merida	m	fmnh	46182	Los Conejos, Mérida	3000	Venezuela	35,9	38,3	46,8	8,5	72,7
Merida	f	amnh	482786	Sierra de Mérida	3000	Venezuela	41,5	38,8	43,0	4,2	69,7
Merida	f	amnh	482788	Páramo del Morro, Mérida	3000	Venezuela	40,7	37,2	39,3	2,1	67,9
Merida	f	amnh	100524	Escorial, Mérida	3000	Venezuela	38,6	36,8	40,6	3,8	68,3
Merida	f	amnh	482781	Escorial, Mérida	3000	Venezuela	40,7	37,4	40,5	3,1	66,9
Merida	f	fmnh	199957	La Culata, Mérida	4400	Venezuela	40,0	36,5	40,6	4,1	65,7
Merida	f	amnh	482783	La Culata, Mérida		Venezuela	39,2	36,5			66,0
Merida	f	amnh	482784	La Culata, Mérida	4000	Venezuela	40,4	36,6	40,6	4,0	68,9
Merida	f	amnh	100526	Conejos, Mérida	3000	Venezuela	39,3	38,3	42,6	4,3	67,5
Tama	m	cop	22490	Boca de Monte, Pregonero, Táchira	2400	Venezuela	35,8	37,8	47,9	10,1	73,1
UNLOCATED	f	cop	49038	Mesa de Lino, Santo Domingo	2700	Venezuela		36,8	43,9	7,1	67,1
UNLOCATED	f	nmnh	437683	Cendé, Páramo Cendé, Trujillo	2700	Venezuela	38,9	36,1	38,7	2,6	67,9

Tabla 11. List of the revised specimens of *Coeligena bonapartei*

SUBSPECIES	POOLS	MUSEUM	SEX	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
helianthea	Santander	nmnh	m	392319	Buenos Aires, Santander North	1900	Colombia		36,6	39,4	2,8	73,6
helianthea	Santander	nmnh	m	392320	Alto del Pozo, Santander North	2950	Colombia	36,7	35,0			74,5
helianthea	Santander	ansp	m	177521	Bucaramanga, Santander	1008	Colombia	35,3	37,0	47,0	10,0	74,9
helianthea	Santander	ansp	m	66606	Ramírez, Santander	2000	Colombia	35,8	34,9	47,3	12,4	74,0
helianthea	Santander	ansp	m	66604	Ramírez, Santander	2000	Colombia		37,7	49,0	11,3	74,1
helianthea	Santander	nmnh	f	401480	Angostura, Santander Norte	2500	Colombia	38,2	34,6	42,0	7,4	68,8
helianthea	Cundinamarca	amnh	m	121587	Chipaque		Colombia	34,0	34,5	44,4	9,9	70,3
helianthea	Cundinamarca	zmk	m	63102	La Calera, Cundinamarca	2718	Colombia	34,5	33,9	43,6	9,7	69,6
helianthea	Cundinamarca	zfmk	m	8534	Pacho (Las Palmas), Bogotá	2500	Colombia	35,3	38,8	46,3	7,5	71,8
helianthea	Cundinamarca	zfmk	m	8533	Pacho (Las Palmas), Bogotá	2500	Colombia	35,5	36,5	47,6	11,1	68,8
helianthea	Cundinamarca	zmk	f	63105	Choachi, Cundinamarca	1966	Colombia	36,6	36,2	40,0	3,8	65,6
helianthea	Cundinamarca	ansp	f	149164	Choachi, Cundinamarca	1670	Colombia	42,1	33,8	39,4	5,6	68,7
helianthea	Cundinamarca	zfmk	f	8537	Pacho (Las Palmas), Bogotá	2500	Colombia	36,1	32,8	42,1	9,3	64,3
helianthea	Cundinamarca	zfmk	f	8538	Pacho (Las Palmas), Bogotá	2500	Colombia	39,5	40,3	43,8	3,5	68,3
helianthea	Cundinamarca	zfmk	f	8540	Pacho (Las Palmas), Bogotá	2500	Colombia	34,9	41,9	42,7	0,8	69,0
tamai	Tama	cop	m	11015	Páramo de Tama (Camp), Táchira	2800	Venezuela	36,7	36,7	49,1		75,9
tamai	Tama	amnh	m	811975	Path to Páramo Tamá, Táchira	2490	Venezuela	35,7	35,6	46,7	11,1	74,3
tamai	Tama	cop	f	11008	Páramo de Tama (Camp), Táchira	2400	Venezuela	42,1	36,5			
tamai	Tama	fmnh	f	43325	Páramo de Tamá, Táchira	1825	Venezuela	40,2	36,1	39,5	3,4	70,7
tamai	Tama	fmnh	f	43326	Páramo de Tamá, Táchira	1825	Venezuela	40,1	35,4	41,3	5,9	70,1

Tabla 12. List of the revised specimens of *Coeligena inca*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
omissa	Urubamba	m	fmnh	324122	on Quillabamba Rd. Above San Luis, Cuzco	3300	Peru	38,3	39,5	44,8	5,3	75,0
omissa	Urubamba	m	nmnh	273118	Torontoy	2620	Peru		40,9	49,3	8,4	74,6
omissa	Urubamba	m	amnh	145052	Santa Rita, Cañón Urubamba, Cuzco		Peru	39,6	43,4	46,9	3,5	74,6
omissa	Urubamba	m	amnh	145054	Santa Rita, Cañón Urubamba, Cuzco		Peru	40,1		49,4		78,5
omissa	Urubamba	m	amnh	145055	Santa Rita, Cañón Urubamba, Cuzco		Peru	38,6	44,7	49,8	5,1	77,1
omissa	Urubamba	f	amnh	145053	San Miguel, Macchu Picchu, Urubamba, Cuzco	1640	Peru	40,8	41,4	41,6	0,2	70,3
omissa	Urubamba	f	zmk	64070	Above Machu Picchu, Cuzco	2600	Peru	38,7	40,1	40,2	0,1	68,8
omissa	Puno	m	amnh	37547	Huaisampillo, Cuzco	2950	Peru		40,9	43,7	2,8	74,7
omissa	Puno	m	amnh	37548	Huaisampillo, Cuzco	2950	Peru		43,2	49,0	5,8	77,2
omissa	Puno	m	amnh	482890	Limbani, Carabaya, Puno	3115	Peru	36,7	41,1	45,1	4,0	74,8
omissa	Puno	m	ansp	103717	Oconeque, Puno		Peru	37,4	41,9	47,0	5,1	74,6
omissa	Puno	m	ansp	103718	Oconeque, Puno		Peru		44,0	49,8	5,8	77,5
omissa	Puno	m	amnh	149866	Camp. No.1 below Limbani, Puno		Peru	37,3	38,3	39,9	1,6	74,0
omissa	Puno	f	fmnh	311747	km 126 on Cospiñata Hwy. Pillahuata, Cuzco	2500	Peru	41,4	41,4	41,8	0,4	69,7
omissa	Puno	f	amnh	37553	Huaisampillo, Cuzco	2950	Peru	41,3	40,2	42,5	2,3	69,6
omissa	Puno	f	ansp	103720	Oconeque, Puno		Peru	39,2	38,1	42,2	4,1	69,3
omissa	Puno	f	ansp	103721	Oconeque, Puno		Peru		40,1	41,8	1,7	70,5
omissa	Puno	f	amnh	149864	Oconeque, Puno	1956	Peru	39,7		42,5		69,7
omissa	Puno	f	amnh	149865	Camp. No. 1, below Limbani		Peru	37,5	40,1	42,9	2,8	70,2
omissa	Puno	f	amnh	482889	Limbani, Carabaya, Puno	3115	Peru	41,0	40,3	41,0	0,7	73,5
inca	La Paz	m	amnh	229177	Ñequejahuira, La Paz	2600	Bolivia		40,5	46,1	5,6	76,3
inca	La Paz	m	zfmk	8631	Chaco		Bolivia	37,9	41,1	47,5	6,4	79,0
inca	La Paz	m	zmk	63096	Chaco, Yungas		Bolivia	37,1	38,8	43,9	5,1	73,9
inca	La Paz	m	amnh	482887	Yungas, Chaco, La Paz		Bolivia	38,2	41,4	46,7	5,3	75,6
inca	La Paz	m	amnh	482884	Yungas, Chaco, La Paz		Bolivia	39,4	41,9	46,3	4,4	75,9
inca	La Paz	m	amnh	482885	Yungas, Chaco, La Paz		Bolivia	37,7	40,0	44,6	4,6	74,5
inca	La Paz	m	amnh	229178	Ñequejahuira, La Paz	2600	Bolivia	39,2	42,7	48,5	5,8	76,9
inca	La Paz	m	zfmk	8632	Chulumani	2750	Bolivia	39,1	39,7	44,7	5,0	73,5
inca	La Paz	m	zfmk	8633	Chulumani	2750	Bolivia	39,8		48,1		79,2
inca	La Paz	f	amnh	482888	Yungas, Chaco, La Paz		Bolivia	40,3	42,1	42,3	0,2	70,6
inca	La Paz	f	zfmk	55826	Camino Lambate, S. Yungas	2400	Bolivia	38,1	38,9	40,5	1,6	69,8
inca	Cochabamba	m	zfmk	8634	San Antonio, Yungas		Bolivia	37,6	40,2	44,9	4,7	73,8
inca	Cochabamba	m	zmk		Tambo Pata, Yungas of Cochabamba	2900	Bolivia	39,2	41,7	48,0	6,3	79,8
inca	Cochabamba	m	zmk		Yungas of Cochabamba, Cochabamba	2900	Bolivia	37,4	44,4	47,4	3,0	77,5
inca	Cochabamba	m	fmnh	179436	Incachaca, Cochabamba	2700	Bolivia	35,6	41,3	49,9	8,6	77,0
inca	Cochabamba	m	zfmk	8635	Incachaca, Cochabamba	2600	Bolivia	38,4	42,9	46,2	3,3	74,0
inca	Cochabamba	m	zfmk	8636	Ceja de Juno, Cochabamba	3000	Bolivia		39,8	39,1	-0,7	68,3
inca	Cochabamba	m	zfmk	8638	Ceja de Juno, Cochabamba	3000	Bolivia	38,1	44,1	46,7	2,6	75,6
inca	Cochabamba	m	zfmk	8639	Ceja de Juno, Cochabamba	3000	Bolivia		39,8	45,2	5,4	76,5
inca	Cochabamba	m	amnh	823760	Río Totora, 15 km N. Monte Punco, Cochabamba	1700	Bolivia	39,9	41,6	46,2	4,6	74,4
inca	Cochabamba	m	amnh	823761	Río Totora, 15 km N. Monte Punco, Cochabamba	1700	Bolivia	37,5	41,2	43,5	2,3	74,6
inca	Cochabamba	f	zfmk	8640	Incachaca, Cochabamba	2700	Bolivia	40,8		40,7		70,1
inca	Cochabamba	f	ansp	145219	Incachaca, Cochabamba	2620	Bolivia		40,9	42,6	1,7	72,1
inca	Cochabamba	f	zfmk	8637	Incachaca, Cochabamba	2500	Bolivia	39,7	39,5	41,3	1,8	70,1
inca	Cochabamba	f	amnh	138677	Incachacha, Cochabamba	2520	Bolivia	39,7	40,1	41,3	1,2	71,4

Table 13. List of the revised specimens of *Coeligena iris* and *C. aurora*

SPECIES	SUBSPECIES	POOLS	SEX	MUSEO	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
aurora		Cocha	m	musm	20038	La Cocha, Cajamarca, Piura	3150	Peru	32,1	37,1	49,2	12,1	78,2
aurora		Cocha	f	musm	20069	La Cocha, Cajamarca, Piura	3150	Peru	34,8	35,1	42,5	7,4	73,2
aurora		Cutervo	m	musm	9915	Bosque de Chiñama, Loma Larga, Lambayeque	2390	Peru	34,3	37,0	51,4	14,4	76,9
aurora		Cutervo	m	musm	9916	Bosque de Chiñama, Loma Larga, Lambayeque	2400	Peru	34,1	35,8			76,7
aurora		Cutervo	m	ansp	118348	Chira, Cajamarca	2460	Peru	32,1				
aurora		Cutervo	m	ansp	118349	Chira, Cajamarca	2460	Peru		34,4	48,2	13,8	76,6
aurora		Cutervo	m	amnh	482950	Cutervo, Cajamarca	2649	Peru	34,1	35,8	48,0	12,2	75,4
aurora		Cutervo	m	amnh	37518	Cutervo, Cajamarca	2649	Peru	33,5	37,3	52,0	14,7	76,2
aurora		Cutervo	m	nmnh	328227	Cutervo, Cajamarca	2649	Peru		39,9	55,2	15,3	79,4
aurora		Cutervo	m	ansp	8676	Cutervo, Cajamarca	2649	Peru	31,2	37,3	52,0	14,7	81,8
aurora		Cutervo	m	ansp	8674	Cutervo, Cajamarca	2649	Peru	32,7	35,5	48,4	12,9	78,8
aurora		Cutervo	m	ansp	8673	Cutervo, Cajamarca	2649	Peru	35,8	36,7	51,6	14,9	78,2
aurora		Cutervo	m	ansp	8685	Cutervo, Cajamarca	2649	Peru	39,7	34,4			72,7
aurora		Cutervo	m	ansp	8625	Cutervo, Cajamarca	2649	Peru	35,6	37,2	49,2	12,0	77,4
aurora		Cutervo	m	ansp	8672	Cutervo, Cajamarca	2649	Peru	31,6	36,5	49,4	12,9	78,6
aurora		Cutervo	m	smf	3654a	Cutervo, Cajamarca	2649	Peru	34,4	36,3	40,5	4,2	78,8
aurora		Cutervo	m	smf		Cutervo, Cajamarca	2649	Peru	34,5	37,0	48,4	11,4	78,1
aurora		Cutervo	m	smf		Cutervo, Cajamarca	2649	Peru	35,1	37,9	54,7	16,8	82,2
aurora		Cutervo	m	smf		Cutervo, Cajamarca	2649	Peru	35,1	37,2	51,8	14,6	77,3
aurora		Cutervo	m	smf		Cutervo, Cajamarca	2649	Peru	34,6	37,7	50,5	12,8	80,7
aurora		Cutervo	m	zfmk	8676	Cutervo, Cajamarca	2649	Peru	31,2	37,3	52,0	14,7	81,8
aurora		Cutervo	m	zfmk	8674	Cutervo, Cajamarca	2649	Peru	32,7	35,5	48,4	12,9	78,8
aurora		Cutervo	m	zfmk	8673	Cutervo, Cajamarca	2649	Peru	35,8	36,7	51,6	14,9	78,2
aurora		Cutervo	m	zfmk	8685	Cutervo, Cajamarca	2649	Peru	39,7	34,4			72,7
aurora		Cutervo	m	zfmk	8625	Cutervo, Cajamarca	2649	Peru	35,6	37,2	49,2	12,0	77,4
aurora		Cutervo	m	zfmk	8672	Cutervo, Cajamarca	2649	Peru	31,6	36,5	49,4	12,9	78,6
aurora		Cutervo	m	musm	20045	Bosque de Cachil, Cajamarca, Rio Chicama	2470	Peru	36,0	40,6	55,4	14,8	86,4
aurora		Cutervo	m	musm	20044	Bosque de Cachil, Cajamarca, Rio Chicama	2470	Peru	37,4	36,9	53,8	16,9	84,0
aurora		Cutervo	m	musm	20063	Bosque de Cachil, Cajamarca, Rio Chicama	2470	Peru	36,5	39,4	54,5	15,1	81,5
aurora		Cutervo	m	musm	2469	Cerca de Cascabamba, cerca Llama	2400	Peru	33,2	34,9	52,2	17,3	79,3
aurora		Cutervo	m	musm	2470	Llama	2095	Peru	33,9	37,0	54,5	17,5	81,0
aurora		Cutervo	m	musm	19530	Camp. Las Carpas, Bosque de Montero, Santa Cruz, Ca	1950	Peru	34,5	36,5	51,5	15,0	80,3
aurora		Cutervo	f	musm	9914	Bosque de Chiñama, Loma Larga, Lambayeque	2250	Peru	36,1	37,8	45,8	8,0	72,8
aurora		Cutervo	f	musm	9917	Bosque de Chiñama, Loma Larga, Lambayeque	2250	Peru	36,5		47,1		71,9
aurora		Cutervo	f	musm	12853	Bosque de Chiñama, Loma Larga, Lambayeque	2250	Peru	36,6	36,7	45,4	8,7	73,0
aurora		Cutervo	f	ansp	118352	Chira, Cajamarca	2460	Peru	38,1	36,8	43,2	6,4	71,2
aurora		Cutervo	f	ansp	118347	Chira, Cajamarca	2460	Peru	35,7	33,8	40,9	7,1	72,1
aurora		Cutervo	f	ansp	118351	Chira, Cajamarca	2460	Peru	35,3	36,0			69,7
aurora		Cutervo	f	ansp	118350	Chira, Cajamarca	2460	Peru		35,2	44,0	8,8	71,1
aurora		Cutervo	f	smf		Cutervo, Cajamarca	2649	Peru	36,4	35,7	46,6	10,9	75,4
aurora		Cutervo	f	smf	3654b	Cutervo, Cajamarca	2649	Peru	38,9	35,5	44,6	9,1	74,0

Table 13. List of the revised specimens of *Coeligena iris* and *C. aurora*

SPECIES	SUBSPECIES	POOLS	SEX	MUSEO	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
aurora		Cutervo	f	ansp	8683	Cutervo, Cajamarca	2649	Peru	37,6	34,3	44,4	10,1	74,4
aurora		Cutervo	f	ansp	8681	Cutervo, Cajamarca	2649	Peru	38,4	37,4	46,8	9,4	77,1
aurora		Cutervo	f	ansp	8684	Cutervo, Cajamarca	2649	Peru	38,4	38,7	44,9	6,2	72,8
aurora		Cutervo	f	ansp	8682	Cutervo, Cajamarca	2649	Peru	37,7	36,5	45,6	9,1	73,3
aurora		Cutervo	f	zfmk	8683	Cutervo, Cajamarca	2649	Peru	37,6	34,3	44,4	10,1	74,4
aurora		Cutervo	f	zfmk	8681	Cutervo, Cajamarca	2649	Peru	38,4	37,4	46,8	9,4	77,1
aurora		Cutervo	f	zfmk	8684	Cutervo, Cajamarca	2649	Peru	38,4	38,7	44,9	6,2	72,8
aurora		Cutervo	f	zfmk	8682	Cutervo, Cajamarca	2649	Peru	37,7	36,5	45,6	9,1	73,3
aurora		Taulis	f	musm	5066	7 km N, 3 km E Chota, Cajamarca	2800	Peru	39,2	36,3	46,3	10,0	76,3
iris	hesperus	Cuenca1	m	smf		Cecche	3275	Ecuador	35,7	38,4	59,1	20,7	82,1
iris	hesperus	Cuenca1	m	zmk	o/n	Azuay, Pacific slope ca. 5 km W Molleturo	3250	Ecuador	35,4	39,5	53,7	14,2	78,9
iris	hesperus	Cuenca1	m	amnh	482951	Molleturo	3250	Ecuador	35,8	40,2	57,4	17,2	79,4
iris	hesperus	Cuenca1	f	smf		Cecche	3275	Ecuador		38,0	52,4	14,4	81,3
iris	hesperus	Cuenca1	f	fmnh	57568	Chical, Cañar	3075	Ecuador	38,5	38,2	47,7	9,5	73,8
iris	hesperus	Cuenca1	f	amnh	182351	Molleturo	3250	Ecuador	39,6	38,7	47,1	8,4	71,8
iris	hesperus	Cuenca2	m	mhnp	1932-3591	Las Palmas, Azuay	2500	Ecuador	35,0	40,9	55,5	14,6	80,6
iris	hesperus	Cuenca2	m	mhnp	1932-3589	Las Palmas, Azuay	2500	Ecuador		37,7	55,5	17,8	83,7
iris	hesperus	Cuenca2	m	mhnp	1936-1299	Cuenca	2535	Ecuador	36,1	38,8	54,5	15,7	79,2
iris	hesperus	Cuenca2	m	amnh	182350	Naranjal to Cuenca	3320	Ecuador	35,6	39,5	58,0	18,5	81,4
iris	hesperus	Cuenca2	m	amnh	482959	Naranjal to Cuenca	3320	Ecuador	36,2	39,0	58,1	19,1	81,1
iris	hesperus	Cuenca2	m	amnh	482956	Naranjal to Cuenca	3320	Ecuador	36,1	38,9	58,8	19,9	83,3
iris	hesperus	Cuenca2	m	amnh	482955	Naranjal to Cuenca	3320	Ecuador	36,1	39,6	59,3	19,7	85,1
iris	hesperus	Cuenca2	m	amnh	482954	Naranjal to Cuenca	3320	Ecuador	35,2	39,2	55,5	16,3	80,8
iris	hesperus	Cuenca2	m	mhnp	1932-3590	El Portete de Tarquí, Azuay	2800	Ecuador	34,3	39,3	55,8	16,5	82,7
iris	hesperus	Cuenca2	m	mhnp	1992-300	Maraiviña, Azuay	3000	Ecuador	34,4		59,1		85,0
iris	hesperus	Cuenca2	m	nmnh	149145	Maraiviña, Azuay	3000	Ecuador	36,9	40,2	54,2	14,0	80,7
iris	hesperus	Cuenca2	m	ansp	65390	Maraiviña, Azuay	3000	Ecuador	37,8				78,5
iris	hesperus	Cuenca2	m	amnh	482953	Cuenca Road	2535	Ecuador	35,7	40,5	56,6	16,1	81,7
iris	hesperus	Cuenca2	f	mhnp	1932-3596	Las Palmas, Azuay	2500	Ecuador	37,4	38,8	51,6	12,8	82,6
iris	hesperus	Cuenca2	f	mhnp	1932-3596b	Las Palmas, Azuay	2500	Ecuador	38,1	38,7			78,5
iris	hesperus	Cuenca2	f	mhnp	1932-3594	Las Palmas, Azuay	2500	Ecuador	37,3	40,8	52,1	11,3	80,5
iris	hesperus	Cuenca2	f	mhnp	1932-3593	Las Palmas, Azuay	2500	Ecuador	37,8	41,4	50,1	8,7	79,9
iris	hesperus	Cuenca2	f	mhnp	1936-1301	Cuenca	2535	Ecuador	40,3	39,7	52,4	12,7	74,8
iris	hesperus	Cuenca2	f	amnh	482957	Naranjal to Cuenca	3320	Ecuador	38,5	37,3	48,5	11,2	72,9
iris	hesperus	Cuenca2	f	amnh	482958	Naranjal to Cuenca	3320	Ecuador		38,0	48,0	10,0	76,5
iris	hesperus	Cuenca2	f	amnh	482960	Naranjal to Cuenca	3320	Ecuador	38,7	36,8	49,4	12,6	76,5
iris	hesperus	Cuenca2	f	mhnp	1992-299	Maraiviña, Azuay	3000	Ecuador	41,1	39,3	52,6	13,3	76,4
iris	hesperus	Cuenca2	f	mhnp	s/n	Maraiviña, Azuay	3000	Ecuador	38,6	36,7	51,0	14,3	79,0
iris	hesperus	Cuenca2	f	mhnp	s/n	Maraiviña, Azuay	3000	Ecuador	35,3	38,3	55,2	16,9	77,2
iris	hesperus	Cuenca2	f	mhnp	s/n	Maraiviña, Azuay	3000	Ecuador	36,9	39,5	62,4	22,9	87,5
iris	hesperus	Cuenca2	f	fmnh	46204	Maraiviña, Azuay	3000	Ecuador	35,2	37,0	45,7	8,7	74,9

Table 13. List of the revised specimens of *Coeligena iris* and *C. aurora*

SPECIES	SUBSPECIES	POOLS	SEX	MUSEO	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
iris	iris	Loja	m	nmnh	388874	Yava Urcu, Azuay	3300	Ecuador	34,6	42,2	59,0	16,8	86,2
iris	iris	Loja	m	amnh	166894	Taraguacocha, Zaruma-Zaraguro trail, Cord de Chila,	3400	Ecuador	35,1	38,1	53,0	14,9	80,6
iris	iris	Loja	m	amnh	166895	Taraguacocha, Zaruma-Zaraguro trail, Cord de Chila,	3400	Ecuador	34,3	39,0	53,6	14,6	80,2
iris	iris	Loja	m	amnh	166893	Taraguacocha, Zaruma-Zaraguro trail, Cord de Chila,	3400	Ecuador		39,4	54,5	15,1	77,9
iris	iris	Loja	m	ansp	8694	between St. Lucas and Loja	2490	Ecuador	34,3	38,1			81,0
iris	iris	Loja	m	zfmk	8694	between St. Lucas and Loja	2490	Ecuador	34,3	38,1			81,0
iris	iris	Loja	m	amnh	482947	San Lucas to Loja	3000	Ecuador	32,7	39,1	51,9	12,8	79,0
iris	iris	Loja	m	amnh	482948	San Lucas to Loja	3000	Ecuador	33,0	34,5	55,8	21,3	80,3
iris	iris	Loja	m	amnh	482946	San Lucas to Loja	3000	Ecuador	34,9	36,5	55,4	18,9	79,6
iris	iris	Loja	m	mhnp	1936-1303	Loja	2200	Ecuador		37,3	52,7	15,4	77,4
iris	iris	Loja	m	mhnp	1936-1302	Loja	2200	Ecuador	36,2	39,7	59,5	19,8	86,1
iris	iris	Loja	m	ansp	181573	Guachanama, Loja	2600	Ecuador	36,0	42,7	57,4	14,7	83,3
iris	iris	Loja	m	amnh	129478	Zamora	3000	Ecuador	34,2	40,1	56,5	16,4	79,0
iris	iris	Loja	m	mcz	298547	Cajanuma Divide, Loja	2450	Ecuador	37,7		45,9		74,4
iris	iris	Loja	m	mcz	298545	Cajanuma Divide, Loja	2450	Ecuador	34,0	42,9	58,1	15,2	83,2
iris	iris	Loja	f	amnh	166896	Salvias, Zaruma-Zaraguro trail, Prov del Oro	1050	Ecuador	37,3	38,4	48,4	10,0	72,6
iris	iris	Loja	f	mhnp	1936-1304	Loja	2200	Ecuador	35,8	38,6	45,3	6,7	72,4
iris	iris	Loja	f	amnh	129477	Loja, Loja	2200	Ecuador	36,3	36,8	44,9	8,1	73,5
iris	iris	Loja	f	amnh	171105	San Bartolo, Alamor Range, Loja	2500	Ecuador	38,0		49,3		70,9
iris	iris	Huamba	m	musm	9820	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	36,2	37,2	55,4	18,2	81,5
iris	iris	Huamba	m	musm	9797	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	36,2	39,8	55,7	15,9	78,2
iris	iris	Huamba	m	musm	9822	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	36,2		57,7		84,6
iris	iris	Huamba	m	musm	9819	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	35,7	38,5	55,5	17,0	78,2
iris	iris	Huamba	m	musm	9821	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	35,2	38,0	55,9	17,9	79,6
iris	iris	Huamba	m	musm	9762	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	35,3	39,5	60,5	21,0	82,3
iris	iris	Huamba	m	musm	9791	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	35,5	38,8	58,1	19,3	80,6
iris	iris	Huamba	m	musm	9763	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	34,9	38,5	57,2	18,7	82,1
iris	iris	Huamba	m	musm	9758	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2960	Peru	36,0	39,4	59,1	19,7	84,6
iris	iris	Huamba	m	musm	12526	Bosque de Huamba, Ayabaca, Piura	2850	Peru	37,2	37,5	57,8	20,3	83,2
iris	iris	Huamba	m	musm	21657	Bosque de Huamba, Ayabaca, Piura	2850	Peru	34,6	38,3	55,6	17,3	79,9
iris	iris	Huamba	m	musm	21622	Bosque de Huamba, Ayabaca, Piura	2850	Peru	36,3	38,9	55,5	16,6	83,9
iris	iris	Huamba	m	musm	21679	Bosque de Huamba, Ayabaca, Piura	2900	Peru	34,5	38,4	54,3	15,9	78,3
iris	iris	Huamba	m	musm	L.Salinas1252	Bosque de Huamba, Ayabaca, Piura	2900	Peru		39,2	56,7	17,5	84,8
iris	iris	Huamba	m	musm	19523	Bosque de Huamba, Ayabaca, Piura	2900	Peru	36,0	39,6	56,4	16,8	84,5
iris	iris	Huamba	m	musm	21689	Bosque de Huamba, Ayabaca, Piura	2900	Peru	35,3	38,5	56,5	18,0	83,9
iris	iris	Huamba	m	musm	19522	Bosque de Huamba, Ayabaca, Piura	2900	Peru	36,4	38,6	54,2	15,6	78,5
iris	iris	Huamba	m	musm	19521	Bosque de Huamba, Ayabaca, Piura	2900	Peru	36,0	38,3	55,6	17,3	84,2
iris	iris	Huamba	m	musm	19528	Bosque de Huamba, Ayabaca, Piura	2900	Peru	35,1	38,3	57,4	19,1	82,3
iris	iris	Huamba	m	musm	M.Samame1159	Bosque de Huamba, Ayabaca, Piura	2900	Peru	35,2	38,6	57,2	18,6	85,4
iris	iris	Huamba	m	musm	M.Samame1161	Bosque de Huamba, Ayabaca, Piura	2950	Peru	34,4	39,2	54,0	14,8	78,8
iris	iris	Huamba	m	musm	21689	Bosque de Huamba, Ayabaca, Piura	2950	Peru	35,3	37,3	56,8	19,5	82,4

Table 13. List of the revised specimens of *Coeligena iris* and *C. aurora*

SPECIES	SUBSPECIES	POOLS	SEX	MUSEO	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
iris	iris	Huamba	m	musm	21689	Bosque de Huamba, Ayabaca, Piura	2950	Peru	35,3	38,0	57,3	19,3	84,2
iris	iris	Huamba	m	musm	9760	Camino de Ayabaca, Prov. Ayabaca, Piura	2950	Peru	34,2	41,3	58,8	17,5	84,4
iris	iris	Huamba	m	musm	13707	Laderas de Yantuma, Ayabaca, Piura	2750	Peru	36,0	38,3	59,9	21,6	83,9
iris	iris	Huamba	f	ansp	184604	18 km E of Limbura, Loja	3100	Ecuador	37,1	38,3	51,1	12,8	76,3
iris	iris	Huamba	f	ansp	184605	9 km E of Limbura, Loja	2700	Ecuador	37,0	39,4	50,1	10,7	74,9
iris	iris	Huamba	f	ansp	185234	W slope Cord Lagunillas, 9 km SSE Jimbura, Loja	2650	Ecuador	36,6	39,7	50,5	10,8	77,8
iris	iris	Huamba	f	musm	9796	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	37,7	36,7	48,0	11,3	74,4
iris	iris	Huamba	f	musm	9761	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	38,5	38,6	50,9	12,3	80,3
iris	iris	Huamba	f	musm	9757	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	38,3	38,8	49,8	11,0	
iris	iris	Huamba	f	musm	19529	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	38,1	38,8	47,7	8,9	74,4
iris	iris	Huamba	f	musm	21692	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	38,3	39,2	49,0	9,8	77,8
iris	iris	Huamba	f	musm	21695	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	37,5	37,4	50,1	12,7	77,7
iris	iris	Huamba	f	musm	12524	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	38,1	40,6	49,2	8,6	74,0
iris	iris	Huamba	f	musm	20648	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	35,2	39,2	46,5	7,3	74,8
iris	iris	Huamba	f	musm	19525	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	37,4	38,0	50,0	12,0	77,1
iris	iris	Huamba	f	musm	19527	44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2850	Peru	37,4	40,5	51,1	10,6	76,0
iris	iris	Huamba	f	musm	13708	Laderas de Yantuma, Ayabaca, Piura	2750	Peru	38,7	38,5	50,2	11,7	78,3
iris	iris	Tambo	m	ansp	118355	El Tambo, Piura	3000	Peru					79,3
iris	iris	Tambo	m	amnh	175148	El Tambo, Piura	2865	Peru	35,7	39,1	55,2	16,1	80,3
iris	iris	Tambo	m	amnh	175147	El Tambo, Piura	2865	Peru	36,0	41,2	55,5	14,3	78,2
iris	iris	Tambo	m	amnh	175146	El Tambo, Piura	2865	Peru	36,2	38,3	52,7	14,4	79,8
iris	iris	Tambo	m	amnh	175145	Palambla, Piura	1310	Peru	34,9	36,2	53,6	17,4	82,5
iris	iris	Tambo	m	ansp	118358	Palambla, Piura	1310	Peru	32,9		52,8		80,3
iris	iris	Tambo	f	musm	6033	Cruz Blanca, 33 km by road SW Huancabamba	2900	Peru	38,5	37,1	47,2	10,1	75,0
iris	iris	Tambo	f	musm	10631	Cruz Blanca, 33 km by road SW Huancabamba	3300	Peru	37,5	37,3	48,3	11,0	75,1
iris	iris	Tambo	f	ansp	118359	Palambla, Piura	1310	Peru			48,2		74,0
iris	iris	Tambo	f	ansp	118360	Palambla, Piura	1310	Peru	36,7	36,8	49,9	13,1	75,6
iris	iris	Tambo	f	ansp	118361	Palambla, Piura	1310	Peru	37,8	39,2	49,3	10,1	75,6
iris	iris	Tambo	f	musm	5118	15 km E (road) E Canchaque on Huancabamba. Puente F	1830	Peru	38,3	35,6	46,7	11,1	73,8
iris	iris	Cocha	m	musm	19573	La Cocha, Cajamarca, Piura	3150	Peru	34,5	38,0	52,6	14,6	80,3
iris	iris	Cocha	m	musm	20043	La Cocha, Cajamarca, Piura	3150	Peru	33,7	36,6	51,3	14,7	77,7
iris	iris	Cocha	m	musm	20042	La Cocha, Cajamarca, Piura	3150	Peru	34,3	36,0	51,6	15,6	77,4
iris	iris	Cocha	f	musm	20039	La Cocha, Cajamarca, Piura	3150	Peru	36,2	38,0	45,9	7,9	73,8
iris	iris	Cocha	f	musm	20070	La Cocha, Cajamarca, Piura	3150	Peru	37,4	34,3	45,0	10,7	72,4
iris	eva	Cutervo	m	ansp	8700	Cutervo, Cajamarca	2649	Peru	34,0	38,5	49,2	10,7	80,2
iris	eva	Cutervo	m	zfmk	8700	Cutervo, Cajamarca	2649	Peru	34,0	38,5	49,2	10,7	80,2
iris	iris	Cutervo	m	ansp	118357	Porculla, Lambayaque	1700	Peru	34,6	37,5	51,9	14,4	81,2
iris	iris	Cutervo	m	ansp	118356	Porculla, Lambayaque	1700	Peru	35,7		54,3		81,3
iris	eva	Cutervo	f	ansp	8701	Cutervo, Cajamarca	2649	Peru	35,5	39,3			73,6
iris	eva	Cutervo	f	zfmk	8701	Cutervo, Cajamarca	2649	Peru	35,5	39,3			73,6
iris	eva	Cutervo	f	musm	20651	Bosque de Cachil, Cajamarca, Rio Chicama	2470	Peru	39,7	38,7	48,3	9,6	78,4

Table 13. List of the revised specimens of *Coeligena iris* and *C. aurora*

SPECIES	SUBSPECIES	POOLS	SEX	MUSEO	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
iris	eva	Cutervo	f	musm	20650	Bosque de Cachil, Cajamarca, Rio Chicama	2470	Peru	40,3	37,3	48,3	11,0	77,3
iris	eva	Cutervo	f	musm	20037	Bosque de Cachil, Cajamarca, Rio Chicama	2470	Peru	41,4	37,5	47,0	9,5	78,3
iris	eva	Cutervo	f	musm	21693	Bosque de Cachil, Cajamarca, Rio Chicama	2470	Peru	40,4	38,2	45,3	7,1	77,2
iris	eva	Cutervo	f	musm	19535	Camp. Las Carpas, Bosque de Montero, Santa Cruz, Ca	1950	Peru	40,1	40,9	47,2	6,3	77,8
iris	eva	Cutervo	f	musm	19537	Camp. Las Carpas, Bosque de Montero, Santa Cruz, Ca	1950	Peru	38,6	38,8	48,0	9,2	
iris	eva	Cutervo	f	musm	20605	Camp. Las Carpas, Bosque de Montero, Santa Cruz, Ca	1950	Peru	39,6	38,3	48,0	9,7	74,7
iris	eva	Cutervo	f	musm	19531	Camp. Las Carpas, Bosque de Montero, Santa Cruz, Ca	1950	Peru	38,0	36,6	47,3	10,7	76,5
iris	eva	Taulis-M	m	musm	20075	El Cedro, Santa Cruz, Cajamarca	2530	Peru	38,4	37,4	51,1	13,7	82,6
iris	eva	Taulis-M	m	musm	20072	El Cedro, Santa Cruz, Cajamarca	2530	Peru	34,8		53,0		
iris	eva	Taulis-M	m	amnh	235793	Taulís, NE Pacasmayo	2670	Peru	35,8	38,8	54,1	15,3	82,1
iris	eva	Taulis-M	m	amnh	235794	Taulís, NE Pacasmayo	2670	Peru	35,7		54,3		78,0
iris	eva	Taulis-M	m	amnh	235795	Seques, NE Pacasmayo	1660	Peru	36,4	35,8	52,8	17,0	81,0
iris	eva	Taulis-M	m	musm	20078	Las Carpas, Cajamarca, Valle del Río Saña	1950	Peru	35,8	36,6	52,7	16,1	82,7
iris	eva	Taulis-M	m	musm	20639	Las Carpas, Cajamarca, Valle del Río Saña	1950	Peru	34,4	37,0	51,6	14,6	79,5
iris	eva	Taulis-M	m	musm	19538	Las Carpas, Cajamarca, Valle del Río Saña	1950	Peru	33,7	35,5	49,7	14,2	
iris	eva	Taulis-M	m	musm	19533	Las Carpas, Cajamarca, Valle del Río Saña	1950	Peru	35,5	35,8	53,0	17,2	
iris	eva	Taulis-M	m	musm	19532	Las Carpas, Cajamarca, Valle del Río Saña	1950	Peru	35,6	37,4	50,0	12,6	79,2
iris	eva	Taulis-M	m	musm	21637	Las Carpas, Cajamarca, Valle del Río Saña	1950	Peru	35,8	37,9	52,3	14,4	79,2
iris	eva	Taulis-M	f	amnh	235790	Chugur, 40 miles NW Cajamarca	2745	Peru	41,0	37,3	47,2	9,9	75,0
iris	eva	Taulis-M	f	amnh	235791	Chugur, 40 miles NW Cajamarca	2745	Peru	38,2	37,0	49,2	12,2	74,5
iris	eva	Taulis-M	f	musm	20666	Las Carpas, Cajamarca, Valle del Río Saña	1950	Peru	39,2	38,7	48,3	9,6	74,8
iris	fulgidiceps	Chachapoyas1	m	smf		Chachapoyas, Amazonas	2335	Peru	33,8	38,0	51,3	13,3	82,6
iris	fulgidiceps	Chachapoyas1	m	smf		Chachapoyas, Amazonas	2335	Peru	34,5	37,3	58,8	21,5	84,0
iris	fulgidiceps	Chachapoyas1	m	smf		Chachapoyas, Amazonas	2335	Peru	35,0	40,1	58,8	18,7	83,8
iris	fulgidiceps	Chachapoyas1	m	smf		Chachapoyas, Amazonas	2335	Peru	34,1	41,1	52,3	11,2	82,3
iris	fulgidiceps	Chachapoyas1	m	amnh	235451	San Pedro, Chachapoyas, Amazonas	2290	Peru	32,1	36,0	50,5	14,5	79,4
iris	fulgidiceps	Chachapoyas1	m	amnh	235454	San Pedro, Chachapoyas, Amazonas	2290	Peru	31,8	36,8	48,0	11,2	74,8
iris	fulgidiceps	Chachapoyas1	m	amnh	235456	San Pedro, Chachapoyas, Amazonas	2290	Peru	33,4	36,0	48,8	12,8	79,3
iris	fulgidiceps	Chachapoyas1	m	amnh	235455	San Pedro, Chachapoyas, Amazonas	2290	Peru	32,4	36,9	50,1	13,2	82,2
iris	fulgidiceps	Chachapoyas1	m	ansp	115564	Leimabamba, Amazonas	2135	Peru	29,2	38,8	51,7	12,9	79,7
iris	fulgidiceps	Chachapoyas1	m	ansp	115565	Leimabamba, Amazonas	2135	Peru	33,7	36,6	47,9	11,3	78,5
iris	fulgidiceps	Chachapoyas1	m	ansp	115566	Leimabamba, Amazonas	2135	Peru	33,9	39,0	53,0	14,0	81,2
iris	fulgidiceps	Chachapoyas1	m	ansp	115567	Leimabamba, Amazonas	2135	Peru	33,2	36,8	49,6	12,8	79,2
iris	fulgidiceps	Chachapoyas1	m	smf		Leimabamba, Amazonas	3300	Peru	32,0	37,0	52,1	15,1	80,6
iris	fulgidiceps	Chachapoyas1	m	amnh	482943	Leimabamba, Amazonas	3320	Peru	33,4	36,3	50,2	13,9	78,1
iris	fulgidiceps	Chachapoyas1	m	musm	11799	ca. 20 km by road W. Leimabamba, Amazonas	3100	Peru	31,9				78,1
iris	fulgidiceps	Chachapoyas1	f	smf		Chachapoyas, Amazonas	2335	Peru	37,8	38,8	47,7	8,9	74,5
iris	fulgidiceps	Chachapoyas1	f	smf		Levanto	2900	Peru	38,1	38,7	47,5	8,8	73,7
iris	fulgidiceps	Chachapoyas1	f	smf		Tamiapampa	2760	Peru	35,0	37,1	46,3	9,2	71,5
iris	fulgidiceps	Chachapoyas1	f	amnh	235452	San Pedro, Chachapoyas, Amazonas	2290	Peru	36,1	37,6	42,7	5,1	72,3
iris	fulgidiceps	Chachapoyas1	f	amnh	235453	San Pedro, Chachapoyas, Amazonas	2290	Peru	37,5	38,8	46,7	7,9	72,2

Table 13. List of the revised specimens of *Coeligena iris* and *C. aurora*

SPECIES	SUBSPECIES	POOLS	SEX	MUSEO	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
iris	fulgidiceps	Chachapoyas1	f	ansp	115568	Leimabamba, Amazonas	2135	Peru	36,9	38,5	50,0	11,5	76,6
iris	fulgidiceps	Chachapoyas1	f	amnh	482944	Leimabamba, Amazonas	3320	Peru	36,8	36,4	47,1	10,7	75,1
iris	fulgidiceps	Chachapoyas1	f	amnh	482945	Leimabamba, Amazonas	3320	Peru	36,4	38,1	43,4	5,3	71,0
iris	fulgidiceps	Chachapoyas1	f	ansp	118362	Lluy, Amazonas	3280	Peru	36,6	35,1	46,0	10,9	73,1
iris	fulgidiceps	Chachapoyas2	m	amnh	234399	La Lejía, Chachapoyas	3000	Peru	32,1	37,4	48,9	11,5	81,6
iris	fulgidiceps	Chachapoyas2	m	amnh	234406	La Lejía, Chachapoyas	3000	Peru	33,8	36,0	50,0	14,0	82,3
iris	fulgidiceps	Chachapoyas2	m	amnh	234401	La Lejía, Chachapoyas	3000	Peru	33,9	37,1	50,3	13,2	80,5
iris	fulgidiceps	Chachapoyas2	m	amnh	234404	La Lejía, Chachapoyas	3000	Peru	32,5	37,9	53,6	15,7	80,6
iris	fulgidiceps	Chachapoyas2	m	amnh	234402	La Lejía, Chachapoyas	3000	Peru	33,5	37,9	53,2	15,3	81,4
iris	fulgidiceps	Chachapoyas2	m	amnh	234403	La Lejía, Chachapoyas	3000	Peru	32,8	37,3	51,5	14,2	80,8
iris	fulgidiceps	Chachapoyas2	m	amnh	234400	La Lejía, Chachapoyas	3000	Peru	33,8	37,0	52,3	15,3	80,3
iris	fulgidiceps	Chachapoyas2	m	amnh	234405	La Lejía, Chachapoyas	3000	Peru	33,3	35,6	50,1	14,5	50,9
iris	fulgidiceps	Chachapoyas2	f	fmnh	46205	Molinopampa, Amazonas	2407	Peru	37,0	36,3	45,3	9,0	74,5
iris	fulgidiceps	Chachapoyas2	f	fmnh	299539	Bosque Millpo, Molinopampa, Amazonas	2620	Peru	36,3	37,0	44,7	7,7	71,5
iris	eva	Cajamarca-M	m	amnh	482962	Cajamarca, Cajamarca	2745	Peru		38,6	51,0	12,4	84,7
iris	eva	Cajamarca-M	m	amnh	482963	Cajabamba, Cajamarca	2745	Peru	37,4	39,0	52,3	13,3	80,0
iris	eva	Cajamarca-M	m	amnh	482967	Succha, Huamachuco	2745	Peru	38,9	40,6	54,9	14,3	82,5
iris	eva	Cajamarca-M	f	amnh	482966	Cajabamba, Cajamarca	2745	Peru	42,6	38,8	45,8	7,0	73,0
iris	eva	Cajamarca-M	f	amnh	482964	Cajabamba, Cajamarca	2745	Peru	41,8	37,5	46,6	9,1	75,2
iris	eva	Cajamarca-M	f	amnh	482965	Cajabamba, Cajamarca	2745	Peru	42,0	38,2	43,1	4,9	76,8
iris	eva	Cajamarca-M	f	ansp	108190	Soquian, Libertad	2590	Peru	40,0	36,6	51,0	14,4	80,7
iris	eva	Cajamarca-M	f	smf		Succha	2900	Peru	42,6	42,0	48,9	6,9	77,8

Table 14. List of the revised specimens of *Coeligena lutetiae*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
albimaculata ssp	Carchi	m	ansp	184601	ca 3 km SE Impueran, W slope Cerro Mongus, Carchi	3300	Ecuador	39,3	37,8	48,3	10,5	75,4
albimaculata ssp	Carchi	m	ansp	185233	ca 3 km SE Impueran, W slope Cerro Mongus, Carchi	3300	Ecuador	39,5	37,4	47,5	10,1	75,7
albimaculata ssp	Carchi	m	zfmk	8590	Camino a Pailon		Ecuador	39,6	36,6	46,3	9,7	76,4
albimaculata ssp	Carchi	f	ansp	180998	W slope, S of road btw Maldonado & Tulcán, S and above	3100	Ecuador	38,1	36,1	43,6	7,5	71,5
albimaculata ssp	Carchi	f	zfmk	8590	Camino a Pailón		Ecuador	44,1	36,8	43,4	6,6	74,5
albimaculata ssp	Pichincha	m	amnh	482809	Pichincha	4875	Ecuador	38,4	39,5	48,3	8,8	75,5
albimaculata ssp	Pichincha	m	mhnp		Nanegal		Ecuador	38,5	37,3	48,8	11,5	76,8
albimaculata ssp	Pichincha	m	bmnh	1969.38.27	Tablaguasi, occidental faldas, Pichincha		Ecuador	37,1	35,6	45,7	10,1	73,4
albimaculata ssp	Pichincha	m	bmnh	1897.11.12.21	Lloa and faldas slopes and Corazon, western Cordillera	3000	Ecuador	40,2	38,0	50,3	12,3	80,2
albimaculata ssp	Pichincha	m	mhnp		Aluguincho		Ecuador	39,2	35,0	49,2	14,2	82,3
albimaculata ssp	Pichincha	m	fmnh	99466	Verdecocha, Pichincha	2850	Ecuador	40,0				78,1
albimaculata ssp	Pichincha	m	zfmk	59125	Verdecocha, Costa	2850	Ecuador	42,1		51,0		79,3
albimaculata ssp	Pichincha	m	zfmk	59124	Verdecocha, Costa	2850	Ecuador	39,4	35,7	48,5	12,8	76,2
albimaculata ssp	Pichincha	m	ansp	163077	Gualea, Pichincha		Ecuador	40,0	37,1	47,0	9,9	75,1
albimaculata ssp	Pichincha	m	amnh	124138	Gualea, Pichincha		Ecuador	40,6	38,0	46,0	8,0	77,0
albimaculata ssp	Pichincha	m	amnh	124140	Gualea, Pichincha		Ecuador	39,9		49,3		78,0
albimaculata ssp	Pichincha	m	amnh	124139	Gualea, Pichincha		Ecuador	40,0	37,0	47,2	10,2	79,0
albimaculata ssp	Pichincha	m	mhnp		Gualea, Pichincha		Ecuador	38,2	36,9	47,7	10,8	79,2
albimaculata ssp	Pichincha	m	nmnh	173680	near Quito	2818	Ecuador		39,6	36,0	-3,6	79,1
albimaculata ssp	Pichincha	m	nmnh	173684	near Quito	2818	Ecuador	39,0	36,3	48,1	11,8	78,0
albimaculata ssp	Pichincha	m	amnh	482810	Pichincha	4875	Ecuador	41,0	36,1	49,0	12,9	76,7
albimaculata ssp	Pichincha	m	amnh	154778	Pichincha	4875	Ecuador	38,9	36,3	40,4	4,1	75,5
albimaculata ssp	Pichincha	m	nmnh	173682	Pichincha	4875	Ecuador		40,1	34,4	-5,7	78,0
albimaculata ssp	Pichincha	m	nmnh	173684	Pichincha	4875	Ecuador		38,9	34,0	-4,9	77,5
albimaculata ssp	Pichincha	m	nmnh	173685	Pichincha	4875	Ecuador		38,3	38,6	0,3	77,8
albimaculata ssp	Pichincha	m	nmnh	173688	Pichincha	4875	Ecuador		40,8	37,5	-3,3	77,7
albimaculata ssp	Pichincha	m	nmnh	173692	Pichincha	4875	Ecuador		39,2	37,8	-1,4	78,2
albimaculata ssp	Pichincha	m	nmnh	173696	Pichincha	4875	Ecuador		39,9	34,4	-5,5	80,2
albimaculata ssp	Pichincha	m	nmnh	173697	Pichincha	4875	Ecuador		37,5			78,1
albimaculata ssp	Pichincha	m	zfmk	8588	Bosques del Cráter, Pichincha	600	Ecuador	39,7	35,5	45,0	9,5	75,3
albimaculata ssp	Pichincha	m	zfmk	8587	Bosques del Cráter, Pichincha	600	Ecuador	39,4	37,9	46,2	8,3	78,6
albimaculata ssp	Pichincha	m	zfmk	81651	Quito	2818	Ecuador	39,3	36,9	40,6	3,7	63,9
albimaculata ssp	Pichincha	m	zfmk	8577	Quito		Ecuador	38,4	36,6	48,8	12,2	75,9
albimaculata ssp	Pichincha	m	mhnp		Lloa (Pichicha, O)	3577	Ecuador	38,8	36,7	46,5	9,8	78,3
albimaculata ssp	Pichincha	m	mhnp		Lloa (Pichicha, O)		Ecuador	38,7		50,9		77,4
albimaculata ssp	Pichincha	m	nmnh	237942	W Corazón		Ecuador	39,1	34,5	47,1	12,6	76,3
albimaculata ssp	Pichincha	m	zfmk	8576	Santo Domingo de Los Colorados	1200	Ecuador	39,7	37,4	47,5	10,1	78,1
albimaculata ssp	Pichincha	m	zfmk	8578	Santo Domingo de Los Colorados	1200	Ecuador	40,3	37,3	47,3	10,0	79,0
albimaculata ssp	Pichincha	m	zfmk	8579	Santo Domingo de Los Colorados	1200	Ecuador	37,7	35,6	48,6	13,0	77,9
albimaculata ssp	Pichincha	f	bmnh	1897.11.12.22	Lloa and faldas slopes and Corazon, western Cordillera	3000	Ecuador	42,5	34,6	45,6	11,0	73,7
albimaculata ssp	Pichincha	f	bmnh	1940.12.5.426	Guarumos, West Eastern Ecuador		Ecuador	43,0	37,7	45,0	7,3	73,8
albimaculata ssp	Pichincha	f	bmnh	1969.37.83	Mt. Tungurahua		Ecuador		34,0	41,5	7,5	71,9
albimaculata ssp	Pichincha	f	amnh	482808	Pichincha	4875	Ecuador	42,0	37,1	42,4	5,3	71,8
albimaculata ssp	Pichincha	f	mhnp		Aluguincho		Ecuador	42,7	35,7	44,5	8,8	70,4
albimaculata ssp	Pichincha	f	mhnp		Aluguincho		Ecuador	44,0	37,6	46,2	8,6	75,7
albimaculata ssp	Pichincha	f	mcz	298805	20km N Pichincha, Cord. Alaspungo		Ecuador	44,0	38,7	44,9	6,2	75,7
albimaculata ssp	Pichincha	f	mhnp		Verdecocha (O)	2850	Ecuador	41,4	37,9	42,7	4,8	71,9
albimaculata ssp	Pichincha	f	amnh	124141	Gualea, Pichincha		Ecuador	40,0	35,4	41,8	6,4	73,3
albimaculata ssp	Pichincha	f	amnh	124142	Gualea, Pichincha		Ecuador	42,3	35,3	41,4	6,1	71,2
albimaculata ssp	Pichincha	f	nmnh	173689	Pichincha	4875	Ecuador		43,3	39,1	-4,2	72,9
albimaculata ssp	Pichincha	f	nmnh	173690	Pichincha	4875	Ecuador	43,4	38,3	45,9	7,6	75,6

Table 14. List of the revised specimens of *Coeligena lutetiae*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
albimaculata ssp	Pichincha	f	nmnh	173693	Pichincha	4875	Ecuador	40,2	38,7	43,6	4,9	74,5
albimaculata ssp	Pichincha	f	nmnh	173694	Pichincha	4875	Ecuador	41,8	37,5	42,7	5,2	73,5
albimaculata ssp	Pichincha	f	nmnh	173700	Pichincha	4875	Ecuador	43,7	35,7	45,3	9,6	73,4
albimaculata ssp	Pichincha	f	nmnh	173701	Pichincha	4875	Ecuador	42,7	35,2	40,7	5,5	72,5
albimaculata ssp	Pichincha	f	zfmk	81365	Quito	2818	Ecuador	41,7	35,4	39,6	4,2	68,6
albimaculata ssp	Pichincha	f	zfmk	81652	Quito	2818	Ecuador	40,3		41,0		68,7
albimaculata ssp	Pichincha	f	fmnh	103018	Quito, Pichincha	2810	Ecuador	42,4	37,7	43,2	5,5	73,1
albimaculata ssp	Pichincha	f	mhnp		Lloa (Pichicha, O)		Ecuador	43,9	36,6	46,0	9,4	79,4
albimaculata ssp	Pichincha	f	mhnp		San Pedro de Taboada	2700	Ecuador	40,0	34,9	48,4	13,5	76,4
albimaculata ssp	Pichincha	f	zfmk	8584	Santo Domingo de Los Colorados	1200	Ecuador	41,6	34,8	44,3	9,5	73,2
albimaculata ssp	Pichincha	f	zfmk	8583	Santo Domingo de Los Colorados	1200	Ecuador	44,3	37,9	45,9	8,0	73,9
albimaculata ssp	Pichincha	f	zfmk	8582	Santo Domingo de Los Colorados	1200	Ecuador	40,9	38,0	44,4	6,4	74,3
albimaculata ssp	Pichincha	f	zfmk	8581	Santo Domingo de Los Colorados	1200	Ecuador	42,3	37,3	44,9	7,6	75,3
lutetiae	Quindio	m	amnh	111584	Santa Isabel, Quindio	3930	Colombia	37,3	33,6	44,5	10,9	72,9
lutetiae	Quindio	m	amnh	111583	Laguneta, W. Quindio, Cauca	3380	Colombia		34,6	47,3	12,7	73,7
lutetiae	Quindio	m	amnh	111579	Laguneta, W. Quindio, Cauca	3380	Colombia	37,6	34,9	47,4	12,5	73,6
lutetiae	Quindio	m	amnh	111580	Laguneta, W. Quindio, Cauca	3380	Colombia	37,0	34,5	45,1	10,6	73,9
lutetiae	Quindio	m	ansp	153439	Laguneta, Caldas	3280	Colombia	36,3	36,1	45,8	9,7	75,3
lutetiae	Quindio	m	ansp	153440	Laguneta, Caldas	3280	Colombia	36,2				72,0
lutetiae	Quindio	f	icn	26242	Termales, Tolima	2400	Colombia	39,7	34,5	43,3		70,1
lutetiae	Quindio	f	icn	26252	Termales, Tolima	2970	Colombia	39,0	33,4			38,5
lutetiae	Quindio	f	icn	26749	Termales, Tolima	2970	Colombia	37,2	34,0	42,8		70,1
lutetiae	Quindio	f	amnh	111582	Laguneta, W. Quindio, Cauca	3380	Colombia	40,4	33,5	41,7	8,2	63,8
lutetiae	Quindio	f	amnh	111581	Laguneta, W. Quindio, Cauca	3380	Colombia	39,3	34,3	46,2	11,9	70,6
lutetiae	Cauca	m	icn	26748	Nevado del Huila, Páez, Cauca		Colombia	38,2	34,1	46,2		75,6
lutetiae	Cauca	m	fmnh	249567	Malrasá, Cauca	3000	Colombia	37,7	34,8	46,4	11,6	73,5
lutetiae	Cauca	m	nmnh	29227	Popayán	1760	Colombia	39,6	35,1	48,8	13,7	77,6
lutetiae	Cauca	m	nmnh	446344	Puracé, km 11, Cauca	2950	Colombia	36,9	36,3	47,7	11,4	70,6
lutetiae	Cauca	m	icn	7744	Paletará, Popayán	3000	Colombia	36,2		49,0		76,9
lutetiae	Cauca	f	icn	26799	Nevado del Huila, Páez, Cauca		Colombia	38,6	36,0	41,5		
lutetiae	Cauca	f	ansp	157253	Paletara, Cauca	2950	Colombia		35,3	40,5	5,2	69,8
lutetiae	Cauca	f	amnh	115908	Almaguer, Cauca	3380	Colombia	40,5	35,2	43,1	7,9	68,2
lutetiae	Llorente	m	fmnh	288032	La Victoria, Nariño	3200	Colombia	38,3	37,9	45,0	7,1	70,6
lutetiae	Llorente	m	fmnh	288037	Llorente, Nariño	3200	Colombia	32,5	36,3	44,4	8,1	75,9
lutetiae	Llorente	m	icn	7745	Páramo Guamués, Nariño	3400	Colombia	38,6	36,8	48,5		76,2
lutetiae	Llorente	m	icn	7746	Páramo Guamués, Nariño	3400	Colombia	38,0	35,8	48,4		76,7
lutetiae	Llorente	m	ansp	161979	Páramo Guamués, Nariño	3400	Colombia		34,6	46,3	11,7	74,7
lutetiae	Llorente	m	ansp	161980	Páramo Guamués, Nariño	3400	Colombia	38,4		49,4		75,8
lutetiae	Llorente	m	ansp	161983	Páramo Guamués, Nariño	3400	Colombia	39,4	35,5	46,1	10,6	76,8
lutetiae	Llorente	m	ansp	161981	Páramo Guamués, Nariño	3400	Colombia	37,7	34,6	45,8	11,2	76,2
lutetiae	Llorente	m	ansp	161984	Páramo Guamués, Nariño	3400	Colombia	39,6	38,2	47,6	9,4	79,3
lutetiae	Llorente	m	fmnh	288034	Llorente, Nariño	3200	Colombia	40,8	37,0	46,3	9,3	75,4
lutetiae	Llorente	f	ansp	161986	Páramo Guamués, Nariño	3400	Colombia	40,9	36,8	43,5	6,7	71,7
lutetiae	Llorente	f	fmnh	288038	Llorente, Nariño	3200	Colombia	43,8	36,9	45,4	8,5	70,2
lutetiae	Llorente	f	fmnh	288035	Llorente, Nariño	3200	Colombia	42,3	33,2	40,1	6,9	65,9
lutetiae	Llorente	f	fmnh	288033	Llorente, Nariño	3200	Colombia	43,1	34,2	42,4	8,2	70,6
lutetiae	Papallacta	m	ansp	163078	Oyacachi, Napo	2500	Ecuador	41,8	37,0	48,2	11,2	81,3
lutetiae	Papallacta	m	amnh	180033	Oyacachi	2500	Ecuador	38,6		45,0		77,4
lutetiae	Papallacta	m	amnh	180034	Oyacachi	2500	Ecuador	38,1	37,7	46,5	8,8	76,8
lutetiae	Papallacta	m	mhnp		Papallacta-Baños	3149	Ecuador	36,1	34,9	44,0	9,1	75,7
lutetiae	Papallacta	m	amnh	247235	Papallacta	3149	Ecuador	38,9		49,4		80,0

Table 14. List of the revised specimens of *Coeligena lutetiae*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
lutetiae	Papallacta	m	amnh	173769	Papallacta	3149	Ecuador	39,3	35,4	46,0	10,6	77,6
lutetiae	Papallacta	m	amnh	180038	Papallacta	3149	Ecuador	39,7	38,0	46,7	8,7	76,0
lutetiae	Papallacta	m	amnh	482806	Papallacta	3149	Ecuador	39,7	35,0	45,3	10,3	77,4
lutetiae	Papallacta	m	nmnh	173706	Papallacta	3149	Ecuador		40,8	34,2	-6,6	
lutetiae	Papallacta	m	nmnh	173707	Papallacta	3149	Ecuador		37,9	36,9	-1,0	78,8
lutetiae	Papallacta	m	nmnh	173711	Papallacta	3149	Ecuador		37,6	36,6	-1,0	75,8
lutetiae	Papallacta	m	nmnh	173712	Papallacta	3149	Ecuador		37,1	35,9	-1,2	74,8
lutetiae	Papallacta	m	nmnh	173713	Papallacta	3149	Ecuador		39,4	36,5	-2,9	
lutetiae	Papallacta	m	nmnh	173714	Papallacta	3149	Ecuador		38,9	38,3	-0,6	75,9
lutetiae	Papallacta	m	zfmk	8591	Papallacta	3149	Ecuador	40,7	38,0	47,5	9,5	75,9
lutetiae	Papallacta	m	zfmk	8586	Papallacta	3149	Ecuador	39,4	36,4	47,5	11,1	78,9
lutetiae	Papallacta	m	zfmk	8592	Papallacta	3149	Ecuador	38,6	37,0	46,4	9,4	78,5
lutetiae	Papallacta	m	zfmk	8585	Papallacta	3149	Ecuador	40,3	35,3	44,4	9,1	75,0
lutetiae	Papallacta	m	mhnp		Papallacta	3149	Ecuador	40,3	39,1	49,4	10,3	74,9
lutetiae	Papallacta	m	mhnp		Papallacta	3149	Ecuador	39,4	36,3	45,3	9,0	76,6
lutetiae	Papallacta	m	mhnp		Papallacta	3149	Ecuador	40,1	37,1	46,6	9,5	76,8
lutetiae	Papallacta	m	fmnh	372425	Lake Papallacta, Napo	3540	Ecuador	37,5	37,2	46,4	9,2	75,4
lutetiae	Papallacta	m	fmnh	372424	Lake Papallacta, Napo	3540	Ecuador	37,0	36,9	46,7	9,8	74,3
lutetiae	Papallacta	m	amnh	185088	Sumaco Arriba	3800	Ecuador	40,6	36,9	45,4	8,5	76,2
lutetiae	Papallacta	m	amnh	185089	Sumaco Arriba	3800	Ecuador	38,9	37,9	46,1	8,2	75,4
lutetiae	Papallacta	m	amnh	185090	Sumaco Arriba	3800	Ecuador	41,5	35,0	46,7	11,7	77,9
lutetiae	Papallacta	m	amnh	185085	Sumaco Arriba	3800	Ecuador	39,6	36,1	45,1	9,0	76,7
lutetiae	Papallacta	f	amnh	180037	Pueblo Viejo, Oyacachi abajo	2500	Ecuador	40,2	34,3	41,2	6,9	70,9
lutetiae	Papallacta	f	amnh	180035	Oyacachi	2500	Ecuador	41,8	36,0	40,2	4,2	70,7
lutetiae	Papallacta	f	amnh	180036	Oyacachi	2500	Ecuador	42,3	34,4	42,7	8,3	70,7
lutetiae	Papallacta	f	amnh	180039	Papallacta	3149	Ecuador	42,5	37,2	40,5	3,3	72,1
lutetiae	Papallacta	f	nmnh	173710	Papallacta	3149	Ecuador	41,8	34,6	40,1	5,5	72,2
lutetiae	Papallacta	f	nmnh	173716	Papallacta	3149	Ecuador	40,3	36,6	43,2	6,6	72,3
lutetiae	Papallacta	f	nmnh	173717	Papallacta	3149	Ecuador	42,7	37,6	43,8	6,2	78,2
lutetiae	Papallacta	f	nmnh	173709	Papallacta	3149	Ecuador	40,0	33,0	42,7	9,7	71,6
lutetiae	Papallacta	f	mhnp		Papallacta	3149	Ecuador	40,2	36,6	44,6	8,0	76,2
lutetiae	Papallacta	f	amnh	185094	Sumaco Arriba	3800	Ecuador	41,8	36,2	38,7	2,5	72,4
lutetiae	Papallacta	f	amnh	185095	Sumaco Arriba	3800	Ecuador	41,8		43,3		72,6
lutetiae	Papallacta	f	amnh	185092	Sumaco Arriba	3800	Ecuador	40,6	36,0	43,5	7,5	71,4
lutetiae	Papallacta	f	amnh	185093	Sumaco Arriba	3800	Ecuador	39,8	35,9	42,3	6,4	71,4
lutetiae	Tungurahua	m	amnh	35551	Ambato		Ecuador	40,1	41,9	48,7	6,8	70,0
lutetiae	Tungurahua	f	mhnp		Alto Pastaza, Env. de Baños		Ecuador	42,8	35,3			
lutetiae	Tungurahua	f	amnh	37534	Río Napo	3000	Ecuador	42,4	35,8	43,1	7,3	70,7
lutetiae	Loja	f	ansp	163079	Portete, Loja		Ecuador	37,7	36,5	43,3	6,8	71,0
lutetiae	Loja	f	ansp	184406	ca 7 km SE Saraguro, Cord Cordoncillo, Loja	3175	Ecuador	40,3	36,4	43,1	6,7	71,1
lutetiae	Loja	f	amnh	482811	Between Loja and Zamora	3280	Ecuador	39,9	37,1	41,4	4,3	69,7
lutetiae	Lagunillas	m	ansp	185231	E slope Cord Lagunillas, ca 25 km road SSE Jimbura, Zamora	3050	Ecuador	36,0	33,7	44,9	11,2	75,0
lutetiae	Lagunillas	m	ansp	185230	E slope Cord Lagunillas, ca 25 km road SSE Jimbura, Zamora	3050	Ecuador	37,1	33,4	46,7	13,3	69,6
lutetiae	Lagunillas	m	fmnh	222197	Huancabamba, Piura	2600	Peru	35,6	35,6	44,9	9,3	73,4
lutetiae	Lagunillas	f	ansp	185232	E slope Cord Lagunillas, ca 25 km road SSE Jimbura, Zamora	3050	Ecuador	41,0	35,6	44,2	8,6	71,7

Table 15. List of the revised specimens of *Coeligena phalerata*

POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
Magdalena	m	amnh	482792	El Líbano, Santa Marta	1850	Colombia	32,7	40,4	46,8	6,4	69,5
Magdalena	m	amnh	73045	El Líbano, Santa Marta	1850	Colombia	34,4	36,8	47,5	10,7	75,1
Magdalena	m	amnh	73041	El Líbano, Santa Marta	1850	Colombia	32,1	37,1	49,0	11,9	70,5
Magdalena	m	amnh	73042	El Líbano	1850	Colombia	32,3	37,1	44,2	7,1	72,2
Magdalena	m	icn	23271	Cebolleta, Cuchilla	2350	Colombia	33,2	37,9	52,3	14,4	76,5
Magdalena	m	icn	21668	San Lorenzo, Santa Marta	2250	Colombia	33,5		49,5		71,1
Magdalena	m	icn	21671	San Lorenzo, Santa Marta	2250	Colombia	34,0				73,3
Magdalena	m	icn	21669	San Lorenzo, Santa Marta	2250	Colombia	34,2				
Magdalena	f	icn	23274	Cebolleta, Cuchilla	2350	Colombia	37,4	36,8	42,0	5,2	66,2
Magdalena	f	icn	23272	Cebolleta, Cuchilla	2350	Colombia	36,8		42,2		69,6
Magdalena	f	icn	23273	Cebolleta, Cuchilla	2480	Colombia	37,3	36,6			70,0
Magdalena	f	amnh	73095	El Líbano, Santa Marta	1850	Colombia		36,4	39,0	2,6	67,6
Magdalena	f	amnh	73096	El Líbano, Santa Marta	1850	Colombia	36,0	34,8	39,8	5,0	67,8
Magdalena	f	icn	21666	San Lorenzo, Santa Marta	2250	Colombia	36,7	35,9	41,9	6,0	68,3
Magdalena	f	icn	21667	San Lorenzo, Santa Marta	2250	Colombia	37,0	34,3	41,0	6,7	70,1
Magdalena	f	icn	21665	San Lorenzo, Santa Marta	2250	Colombia	35,9	35,4	39,9	4,5	67,0
Magdalena	f	icn	21663	San Lorenzo, Santa Marta	2250	Colombia	36,3	36,8	41,7	4,9	67,7
Magdalena	f	icn	21670	San Lorenzo, Santa Marta	2250	Colombia	39,9		42,2		68,9
Magdalena	f	icn	20513	San Lorenzo, Santa Marta	2150	Colombia	38,2	36,2	41,6	5,4	68,3
Magdalena	f	icn	21662	San Lorenzo, Santa Marta	2150	Colombia	36,4	36,7	42,5	5,8	67,4
Magdalena	f	icn	23276	San Lorenzo, Santa Marta	2150	Colombia	38,4	36,4	44,5	8,1	67,8
Guajira	m	ansp	62773	Cerro Caracas, Santa Marta		Colombia		36,6	47,9	11,3	72,6
Guajira	m	ansp	62781	San Miguel, Santa Marta	1700	Colombia		35,9	46,1	10,2	72,8
Guajira	m	ansp	62783	San Miguel, Santa Marta	1700	Colombia	33,5	35,4	48,0	12,6	72,8
Guajira	m	ansp	62784	San Miguel, Santa Marta	1700	Colombia	32,8	35,3	46,0	10,7	71,5
Guajira	m	icn	7687	San Miguel, Santa Marta	1700	Colombia	32,0	36,1			75,1
Guajira	f	ansp	62786	San Miguel, Santa Marta	1700	Colombia	36,8	35,0	42,0	7,0	70,0
Cesar	m	nmnh	386961	El Mamón, 4 miles above San Sebastián, Sierra de	2100	Colombia	32,6	37,8	48,7	10,9	75,3
Cesar	m	nmnh	386962	El Mamón, 4 miles above San Sebastián, Sierra de	2100	Colombia	33,4	37,7			73,3
Cesar	m	nmnh	386952	Simínchucua, Sierra de Santa Marta	2550	Colombia	34,3	36,1	48,6	12,5	72,4
Cesar	m	nmnh	386953	Simínchucua, Sierra de Santa Marta	2550	Colombia	34,3	38,0	48,7	10,7	75,7
Cesar	m	nmnh	386954	Simínchucua, Sierra de Santa Marta	2550	Colombia	33,3	38,5			76,0
Cesar	m	nmnh	386955	Simínchucua, Sierra de Santa Marta	2550	Colombia	35,2	37,5	49,3	11,8	74,5
Cesar	m	nmnh	386942	Chenducua, Río Guatapurí, Sierra de Santa Marta	1800	Colombia	33,5	37,5	48,3	10,8	76,7
Cesar	m	nmnh	386943	Chenducua, Río Guatapurí, Sierra de Santa Marta	1800	Colombia	33,5	36,1	47,2	11,1	77,3
Cesar	m	nmnh	386944	Chenducua, Río Guatapuri, Sierra de Santa Marta	1800	Colombia	34,9	38,1	49,7	11,6	76,1
Cesar	m	nmnh	386950	Main valley, S side Río Guatapurí, Sierra Santa	3280	Colombia	34,0	37,7	47,3	9,6	73,6
Cesar	m	nmnh	386951	Main valley, S side Río Guatapurí, Sierra Santa	3280	Colombia	33,5	35,0	46,3	11,3	73,1
Cesar	f	nmnh	386945	Chenducua, Río Guatapurí, Sierra de Santa Marta	1800	Colombia	35,7	37,6	41,9	4,3	67,9
Cesar		nmnh	386946	Chenducua, Río Guatapurí, Sierra de Santa Marta	1800	Colombia	36,1	37,8	42,8	5,0	69,1
Cesar		nmnh	386947	Chenducua, Río Guatapurí, Sierra de Santa Marta	1800	Colombia	38,4	37,3	42,8	5,5	67,7
Cesar		nmnh	386948	Chenducua, Río Guatapurí, Sierra de Santa Marta	1800	Colombia	36,7	35,6	41,2	5,6	65,8
Cesar		nmnh	386949	Chenducua, Río Guatapurí, Sierra de Santa Marta	1800	Colombia	37,4	36,1	42,5	6,4	70,0
Cesar		nmnh	386963	El Mamón, 4 miles above San Sebastián, Sierra de Santa Marta	2100	Colombia		35,7	41,5	5,8	70,4
Cesar		nmnh	386956	Simínchucua, Sierra de Santa Marta	2550	Colombia	36,6	36,0	41,6	5,6	68,6
Cesar		nmnh	386957	Simínchucua, Sierra de Santa Marta	2550	Colombia	38,0	36,4	42,3	5,9	69,9
Cesar		nmnh	386958	Simínchucua, Sierra de Santa Marta	2550	Colombia		37,4	42,0	4,6	67,9
Cesar		nmnh	386960	Simínchucua, Sierra de Santa Marta	2550	Colombia	35,3	35,9	40,6	4,7	66,5

Table 16. List of the revised specimens of *Coeligena prunellei*

POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
Virolin	m	icn	25480	Charalá, Cañaverales		Colombia	32,5	38,7	51,5	12,8	78,0
Virolin	m	nmnh	372904	Virolín, 28 km S of Charalá, Santader Sur	1800	Colombia		39,3	50,9	11,6	78,4
Virolin	m	nmnh	372906	Virolín, 28 km S of Charolá-Duitamard. Santander	1800	Colombia	31,2	38,0	49,5	11,5	77,8
Virolin	m	nmnh	372905	Virolín, 28 km S of Charolá-Duitamard. Santander	1800	Colombia	33,1	38,0	51,0	13,0	78,6
Virolin	m	icn	25476	Virolín, Loma del Rey		Colombia	32,3	38,5	50,8	12,3	72,9
Virolin	f	icn	25385	(Virolín) Buenavista, La Argentina		Colombia	34,1	37,1	45,2	8,1	73,3
Virolin	f	icn		Curso de Campo, Virolín		Colombia	33,4	35,6	42,7	7,1	70,3
Virolin	f	icn	25047	Curso de Campo, Virolín		Colombia	34,0	36,9	42,0	5,1	69,8
Virolin	f	icn	25387	Virolín, Loma del Rey		Colombia	33,1	37,9			71,2
Virolin	f	icn	25386	Virolín, Loma del Rey		Colombia	33,2	37,1	41,8	4,7	71,8
Bogotá	m	cks	9650	Bogotá	3200	Colombia	31,4	38,3	47,0	8,7	76,7
Pedropalo	m	icn	27690	Tena, Laguna	2010	Colombia	31,9	38,0	51,3	13,3	75,5
Pedropalo	f	icn	15657	La Vega, Vda. El Roble	2400	Colombia	33,6	37,1	43,3	6,2	69,5
Pedropalo	f	icn	23846	Laguna Pedropalo, Santander	2010	Colombia	32,0	36,1			71,2
Pedropalo	f	icn	18731	Pedropalo	2010	Colombia	31,3	39,2	49,8	10,6	76,2
Pedropalo	f	icn	17276	Pedropalo	2010	Colombia	31,6	37,9	43,2	5,3	71,6
Pedropalo	f	icn	20480	Pedropalo	2010	Colombia	31,7	38,5	52,6	14,1	77,5
Pedropalo	f	icn	20510	Pedropalo	2010	Colombia	32,2	41,3			79,2
Pedropalo	f	icn	20400	Pedropalo	2010	Colombia	32,7	38,2	49,8	11,6	76,3
Pedropalo	f	icn	20302	Pedropalo	2010	Colombia	33,5	36,7	52,2	15,5	78,4
Pedropalo	f	icn	18732	Pedropalo	2010	Colombia	33,8	36,8	45,1	8,3	72,1
Pedropalo	f	icn	18733	Pedropalo	2010	Colombia	33,9	42,2	56,4	14,2	81,1
Pedropalo	f	icn	17275	Pedropalo	2010	Colombia	35,4	36,0	43,9	7,9	70,3

Table 17. List of the revised specimens of *Coeligena torquata*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
hybrids(traviesi)	Cundinamarca		amnh	37570	Santa Fe de Bogotá		Colombia	35,9	37,4	46,0	8,6	70,9
fulgidigula	Pichincha	m	amnh	124145	Gualea, Pichincha		Ecuador	40,3	40,9	44,4	3,5	76,0
fulgidigula	Pichincha	m	amnh	124143	Gualea, Pichincha		Ecuador	38,8	41,2	44,6	3,4	78,9
fulgidigula	Pichincha	m	amnh	124149	Gualea, Pichincha		Ecuador	36,6	41,0	44,9	3,9	73,4
fulgidigula	Pichincha	m	amnh	124144	Gualea, Pichincha		Ecuador	39,0		44,6		77,9
fulgidigula	Pichincha	m	ansp	163076	Gualea, Pichincha	1500	Ecuador	42,7				77,6
fulgidigula	Pichincha	m	mhnp		Huila		Ecuador	39,0	39,9	46,5	6,6	79,4
fulgidigula	Pichincha	m	mcz	298329	20km N Pichincha, Cord. Alaspungo		Ecuador	38,0	40,7	44,5	3,8	75,4
fulgidigula	Pichincha	m	mcz	8004	Calacalí		Ecuador	38,2	39,6	47,3	7,7	
fulgidigula	Pichincha	m	ansp	163075	El Castillo (near Santo Domingo de Los Colorados), Pichincha		Ecuador	39,9	39,8	46,2	6,4	79,0
fulgidigula	Pichincha	m	amnh	810889	Mojanda Abajo, Pichincha/Imbabura		Ecuador	37,9	41,7	46,2	4,5	77,6
fulgidigula	Pichincha	m	amnh	482872	Mt. Pichincha, Pichincha	4875	Ecuador	34,9	41,4	45,9	4,5	77,6
fulgidigula	Pichincha	m	amnh	482873	Mt. Pichincha, Pichincha	4875	Ecuador	37,0	41,3	46,3	5,0	77,5
fulgidigula	Pichincha	m	nmnh	173743	lower W side of Pichincha		Ecuador	39,3	41,1	46,0	4,9	74,9
fulgidigula	Pichincha	m	ansp	169830	West side Mt. Pichincha		Ecuador	40,8				76,5
fulgidigula	Pichincha	m	zfmk	84120	North Quito	2818	Ecuador	39,8	40,7	48,0	7,3	77,5
fulgidigula	Pichincha	m	zfmk	84257	Quito	2818	Ecuador	39,2	43,6			
fulgidigula	Pichincha	m	amnh	482874	Lloa, Pichincha	3577	Ecuador	40,0	41,7	43,8	2,1	76,9
fulgidigula	Pichincha	m	nmnh	173737	Conyacota (=Miligalli?)	1800	Ecuador	40,4	40,5	46,7	6,2	77,6
fulgidigula	Pichincha	m	nmnh	173739	Conyacota (=Miligalli?)	1800	Ecuador	38,0	40,3	46,8	6,5	79,4
fulgidigula	Pichincha	m	nmnh	173736	Conyacota (=Miligalli?)	1800	Ecuador	38,8	40,0	44,9	4,9	77,9
fulgidigula	Pichincha	m	nmnh	173734	Conyacota (=Miligalli?)	1800	Ecuador	38,7	41,4	43,7	2,3	78,6
fulgidigula	Pichincha	m	nmnh	173751	Millagalli		Ecuador	37,9	42,2	46,5	4,3	79,7
fulgidigula	Pichincha	m	nmnh	173748	Millagalli		Ecuador	37,7	40,5	46,2	5,7	76,5
fulgidigula	Pichincha	m	nmnh	173746	Mindo, Quito		Ecuador	39,6	42,1	47,6	5,5	80,7
fulgidigula	Pichincha	m	amnh	802122	Cerro Palma		Ecuador	37,9	39,1	44,3	5,2	74,4
fulgidigula	Pichincha	m	zfmk	8623	Paichigal, Río Tambillo		Ecuador	36,6	43,0	46,9	3,9	78,8
fulgidigula	Pichincha	m	zfmk	8629	Paichigal, Río Tambillo		Ecuador	39,3	42,1	46,5	4,4	78,9
fulgidigula	Pichincha	m	zfmk	8628	Paichigal, Río Tambillo		Ecuador	39,6	41,0	45,9	4,9	76,2
fulgidigula	Pichincha	m	zfmk	8630	Paichigal, Río Tambillo		Ecuador	38,4	43,5	45,6	2,1	77,3
fulgidigula	Pichincha	f	amnh	124148	Gualea, Pichincha		Ecuador	40,8	39,8	39,5	-0,3	74,8
fulgidigula	Pichincha	f	amnh	124146	Gualea, Pichincha		Ecuador	40,0	39,5	40,7	1,2	71,3
fulgidigula	Pichincha	f	amnh	124147	Gualea, Pichincha		Ecuador	41,5	42,1	41,0	-1,1	70,7
fulgidigula	Pichincha	f	amnh	154780	Gualea, Pichincha		Ecuador	42,8	32,7	39,0	6,3	69,8
fulgidigula	Pichincha	f	mhnp		Huila		Ecuador	41,9	41,3	41,4	0,1	74,3
fulgidigula	Pichincha	f	mcz	298328	20km N Pichincha, Cord. Alaspungo		Ecuador	40,3	38,2	42,1	3,9	70,9
fulgidigula	Pichincha	f	amnh	810887	Mojanda Abajo, Pichincha/Imbabura		Ecuador	40,8	39,0	39,3	0,3	72,7
fulgidigula	Pichincha	f	amnh	810888	Mojanda Abajo, Pichincha/Imbabura		Ecuador	43,9	39,3	42,9	3,6	73,3
fulgidigula	Pichincha	f	nmnh	173741	lower W side of Pichincha		Ecuador	41,3		40,2		72,5
fulgidigula	Pichincha	f	nmnh	173740	lower W side of Pichincha		Ecuador	41,0	37,4	39,7	2,3	71,1
fulgidigula	Pichincha	f	zfmk	84256	Quito	2818	Ecuador	39,9	39,5	41,0	1,5	
fulgidigula	Pichincha	f	nmnh	173732	Conyacota (=Miligalli?)	1800	Ecuador	41,6	39,6	40,1	0,5	73,6
fulgidigula	Pichincha	f	nmnh	173733	Conyacota (=Miligalli?)	1800	Ecuador	40,7	39,2	39,9	0,7	71,6
fulgidigula	Pichincha	f	nmnh	173750	Millagalli		Ecuador	39,9	38,0	40,2	2,2	70,3
fulgidigula	Pichincha	f	nmnh	173749	Millagalli		Ecuador	38,8	38,4	39,9	1,5	74,8

Table 17. List of the revised specimens of *Coeligena torquata*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
fulgidigula	Pichincha	f	zfmk	8625	Paichigal, Río Tambillo		Ecuador	42,0	39,0	40,8	1,8	70,0
fulgidigula	Pichincha	f	zfmk	8626	Paichigal, Río Tambillo		Ecuador	40,5	39,2	41,4	2,2	72,5
fulgidigula	Pichincha	f	nmnh	173745	lower W side of Corazón	4791	Ecuador	40,4	37,9	41,0	3,1	69,2
fulgidigula	Pichincha	f	nmnh	173744	lower W side of Corazón	4791	Ecuador	41,6	36,6	37,4	0,8	70,1
fulgidigula	Pichincha	f	amnh	447338	Guarumo, Pichincha		Ecuador	38,0	40,2	44,2	4,0	76,4
fulgidigula	Chimborazo	m	zfmk	8622	Santo Domingo de Los Colorados	500	Ecuador	38,7	40,5	44,5	4,0	78,6
fulgidigula	Chimborazo	m	amnh	173210	Pallatanga, Chimborazo	1500	Ecuador	40,5	42,4	48,4	6,0	76,8
fulgidigula	Chimborazo	m	ansp	59173	Hacienda Jalancay, Chunchi, Chimborazo	2130	Ecuador	40,1	42,3	45,7	3,4	72,6
fulgidigula	Chimborazo	m	ansp	59172	Hacienda Jalancay, Chunchi, Chimborazo	2130	Ecuador	40,2	40,1	46,5	6,4	77,4
fulgidigula	Chimborazo	m	ansp	59175	Pagma forest, Chunchi, Chimborazo		Ecuador	42,1	41,6	47,3	5,7	77,0
fulgidigula	Chimborazo	m	ansp	59174	Pagma forest, Chunchi, Chimborazo		Ecuador	41,8	40,9	45,0	4,1	68,5
fulgidigula	Chimborazo	f	fmnh	302743	Riobamba, Chimborazo	2754	Ecuador	41,1	40,1	44,6	4,5	68,3
fulgidigula	Chimborazo	f	ansp	59171	Hacienda Jalancay, Chunchi, Chimborazo	1800	Ecuador	41,5	40,5	41,6	1,1	69,5
torquata	Tama	m	cop	62014	Hacienda La Providencia, Río Chiquito, Táchira	2300	Venezuela	38,6	40,0	46,0	6,0	76,9
torquata	Tama	m	cop	10799	Villa Páez, Páramo Tamá, Táchira	2500	Venezuela	42,2	41,9	47,9	6,0	76,2
torquata	Tama	m	fmnh	43323	Páramo de Tamá, Táchira	1825	Venezuela	40,5	41,8	45,6	3,8	76,7
torquata	Tama	m	cop	75287	Cerro El Cobre, Páramo Tamá, Táchira	2800	Venezuela	39,3	37,9			75,0
torquata	Tama	f	cop	62015	Hacienda La Providencia, Río Chiquito, Táchira	2200	Venezuela	40,9	38,8	40,7	1,9	70,3
torquata	Tama	f	cop	62016	Hacienda La Providencia, Río Chiquito, Táchira	2100	Venezuela	41,3				68,8
torquata	Tama	f	cop	10587	Delicias, Páramo Tamá, Táchira	2340	Venezuela	42,3	38,8	40,6	1,8	65,2
torquata	Tama	f	cop	10586	Las Delicias, Páramo Tamá	2400	Venezuela	42,2	38,5	37,1	-1,4	
torquata	Tama	f	cop	74394	Copas, La Rebancha, Táchira	2300	Venezuela	40,9	39,2	42,0	2,8	73,0
torquata	Tama	f	cop	75286	Cerro El Cobre, Páramo Tamá, Táchira	2800	Venezuela	42,7	38,1	38,2	0,1	
torquata	Tama	f	fmnh	43324	Páramo de Tamá, Táchira	1825	Venezuela	41,9	42,5	42,0	-0,5	71,8
torquata	Las Vegas	m	nmnh	410765	Hacienda Las Vegas, Santander	1970	Colombia	41,4	41,9	48,4	6,5	74,6
torquata	Las Vegas	m	nmnh	410763	Hacienda Las Vegas, Santander	1970	Colombia	40,5	42,3	47,5	5,2	77,5
torquata	Bucaramanga	m	ansp	173572	Bucaramanga, Santander	1008	Colombia	39,6	40,6	45,8	5,2	80,4
torquata	Bucaramanga	m	ansp	173571	Bucaramanga, Santander	1008	Colombia	40,1	42,6	44,8	2,2	78,0
torquata	Cundinamarca	m	amnh		Panamá, above Pacho, Cundinamarca	2100	Colombia	36,7				75,3
torquata	Cundinamarca	m	amnh	124457	Subia, near La Mesa, Cundinamarca	1900	Colombia	39,0	38,1	39,4	1,3	65,1
torquata	Cundinamarca	m	ansp	168280	Aguabonita, Mun de Silvania, Cundinamarca	2300	Colombia	35,2	41,7	47,1	5,4	76,8
torquata	Cundinamarca	m	amnh	121597	El Peñón (above Fusagasugá), Cundinamarca	3150	Colombia	36,9	39,3	42,2	2,9	75,4
torquata	Cundinamarca	m	ansp	168278	La Aguadita, Cundinamaca		Colombia	38,0	38,2	41,4	3,2	72,3
torquata	Cundinamarca	m	ansp	168275	La Aguadita, Cundinamaca		Colombia	37,0	41,6	47,1	5,5	79,9
torquata	Cundinamarca	m	ansp	168279	La Aguadita, Cundinamaca		Colombia	36,3	41,5	45,0	3,5	77,4
torquata	Cundinamarca	m	amnh	121590	El Roble, above Fusagasugá	2620	Colombia	36,2	43,2	46,5	3,3	77,6
torquata	Cundinamarca	m	amnh	121592	El Roble, above Fusagasugá	2620	Colombia	37,9	40,4	44,7	4,3	75,4
torquata	Cundinamarca	m	fmnh	50977	El Roble, above Fusagasugá	2620	Colombia	38,2	40,9	46,3	5,4	77,0
torquata	Cundinamarca	m	mhnp		Fusagasuga	1746	Colombia	37,7	38,8	45,8	7,0	77,1
torquata	Cundinamarca	f	zfmk	8615	Páramos de Bogotá		Colombia	40,5	41,4	40,6	-0,8	70,6
torquata	Cundinamarca	f	amnh	121594	El Roble, above Fusagasugá	2620	Colombia		38,7	43,2	4,5	70,9
torquata	Cundinamarca	f	amnh	121595	El Peñón (above Fusagasugá), Cundinamarca	3150	Colombia	38,7	38,8	40,5	1,7	70,0
torquata	Antioquia	m	nmnh	425737	Hacienda Zulaiba, 17 miles NE Santa Rosa de Osos, Antioquia	2790	Colombia	35,4	41,1	46,6	5,5	75,6
torquata	Antioquia	m	nmnh	425736	Hacienda Zulaiba, 17 miles NE Santa Rosa de Osos, Antioquia	2790	Colombia	37,8	42,2	49,5	7,3	80,2
torquata	Antioquia	m	nmnh	425735	Hacienda Zulaiba, 17 miles NE Santa Rosa de Osos, Antioquia	2790	Colombia	37,9	42,2	47,5	5,3	76,0

Table 17. List of the revised specimens of *Coeligena torquata*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
torquata	Antioquia	m	nmnh	425734	Hacienda Zulaiba, 17 miles NE Santa Rosa de Osos, Antioquia	2790	Colombia	36,8	43,4	44,9	1,5	75,5
torquata	Antioquia	m	cks	8927	Monte (Alto) Socorro, West Cordiller.	3500	Colombia	37,4	44,3	48,2	3,9	75,3
torquata	Antioquia	m	cks	8928	Monte (Alto) Socorro, West Cordiller.	3600	Colombia	37,8		49,6		77,8
torquata	Antioquia	m	cks	8929	Monte (Alto) Socorro, West Cordiller.	3400	Colombia		42,9	47,9	5,0	75,8
torquata	Antioquia	m	nmnh	436227	Páramo Frontino, Antioquia	3890	Colombia	40,8	41,6	50,6	9,0	77,1
torquata	Antioquia	m	amnh	154460	Santa Elena, Antioquia	2750	Colombia		41,4	45,7	4,3	77,2
torquata	Antioquia	m	amnh	133137	Santa Elena, Antioquia	2750	Colombia	35,7	41,7	46,3	4,6	76,8
torquata	Antioquia	m	amnh	133139	Santa Elena, Antioquia	2750	Colombia	36,0	42,5	48,5	6,0	78,1
torquata	Antioquia	m	nmnh	255920	Santa Elena, Antioquia	2750	Colombia	35,8		46,9		74,8
torquata	Antioquia	m	amnh	110752	Antioquia, Antioquia		Colombia		42,2	50,4	8,2	78,2
torquata	Antioquia	m	nmnh	436224	Páramo Sonsón, Antioquia		Colombia	37,5	42,1	50,0	7,9	78,4
torquata	Antioquia	m	nmnh	436223	Páramo Sonsón, Antioquia		Colombia	35,2	42,2	48,9	6,7	75,8
torquata	Antioquia	f	nmnh	425743	Hacienda Zulaiba, 17 miles NE Santa Rosa de Osos, Antioquia	2790	Colombia	38,7	39,9	41,2	1,3	69,3
torquata	Antioquia	f	nmnh	425742	Hacienda Zulaiba, 17 miles NE Santa Rosa de Osos, Antioquia	2790	Colombia	37,3	37,8	42,0	4,2	69,7
torquata	Antioquia	f	nmnh	425741	Hacienda Zulaiba, 17 miles NE Santa Rosa de Osos, Antioquia	2790	Colombia	39,6	42,9	44,0	1,1	71,3
torquata	Antioquia	f	nmnh	425740	Hacienda Zulaiba, 17 miles NE Santa Rosa de Osos, Antioquia	2790	Colombia	37,1	39,4	42,7	3,3	72,3
torquata	Antioquia	f	nmnh	425738	Hacienda La Ilusión, Río Urao, base of Páramo Frontino, Antioquia	2930	Colombia	36,9	43,2	48,4	5,2	75,8
torquata	Antioquia	f	nmnh	436226	Hacienda La Ilusión, Río Urao, base of Páramo Frontino, Antioquia	2930	Colombia	40,4	40,9	42,5	1,6	72,4
torquata	Antioquia	f	amnh	154459	Medellín, Antioquia	1538	Colombia	36,5	39,8	41,0	1,2	67,2
torquata	Antioquia	f	amnh	133141	Santa Elena, Antioquia	2750	Colombia	38,3	40,8	41,4	0,6	72,4
torquata	Antioquia	f	nmnh	436225	Páramo Sonsón, Antioquia		Colombia	37,9	40,2	42,5	2,3	70,7
torquata	Antioquia	f	cks	8931	Monte (Alto) Socorro, West Cordiller.	3600	Colombia	38,4	37,6	41,1	3,5	68,9
torquata	Antioquia	f	cks	8930	Monte (Alto) Socorro, West Cordiller.	3400	Colombia	36,3		43,2		72,6
torquata	Tolima	m	cks	8925	Nevado del Tolima, Tolima	3200	Colombia	33,8	41,1	45,7	4,6	78,8
torquata	Tolima	m	zfmk	8616	Cordill. Tolima, Bogotá		Colombia	36,4	41,4	45,3	3,9	75,7
torquata	Tolima	m	nmnh	255922	W Quindio, above Salento, Cauca	2949	Colombia	37,3	42,8	50,3	7,5	84,4
torquata	Tolima	m	ansp	153420	Toche, Tolima	2400	Colombia	36,3	39,2	45,7	6,5	80,8
torquata	Tolima	m	ansp	153421	Toche, Tolima	2400	Colombia	35,7				76,7
torquata	Tolima	m	ansp	153422	Toche, Tolima	2400	Colombia	35,9	40,7	46,4	5,7	77,3
torquata	Tolima	m	ansp	153418	Toche, Tolima	2360	Colombia	35,2	42,7	47,9	5,2	79,9
torquata	Tolima	m	ansp	153419	Toche, Tolima	2360	Colombia	35,6	42,3	46,9	4,6	78,0
torquata	Tolima	m	ansp	153414	Toche, Tolima	2300	Colombia	36,9	41,1	45,8	4,7	76,2
torquata	Tolima	m	ansp	153415	Toche, Tolima	2300	Colombia	36,1	40,4	47,3	6,9	78,3
torquata	Tolima	m	ansp	153408	Toche, Tolima	2230	Colombia	35,6	38,8	42,9	4,1	74,1
torquata	Tolima	m	ansp	153410	Toche, Tolima	2230	Colombia	35,5	40,5	46,6	6,1	78,9
torquata	Tolima	m	ansp	153426	Laguneta	2790	Colombia	34,7				77,9
torquata	Tolima	m	ansp	153427	Laguneta	2790	Colombia	38,7	41,5			
torquata	Tolima	m	ansp	153425	Laguneta	2300	Colombia	38,6	43,3	51,2	7,9	82,1
torquata	Tolima	m	amnh	111585	El Edén, E. Quindio, Tolima	2700	Colombia	36,2	43,8	46,8	3,0	73,2
torquata	Tolima	m	amnh	111587	El Edén, E. Quindio, Tolima	2700	Colombia	35,4	42,3	47,1	4,8	77,1
torquata	Tolima	f	ansp	153429	Laguneta	3280	Colombia					68,2
torquata	Tolima	f	ansp	153433	Salento, Caldas	2300	Colombia	38,4	41,4	41,5	0,1	74,8
torquata	Tolima	f	amnh	111588	W. Quindio, above Salento, Quindío	2950	Colombia	37,9	39,4	40,6	1,2	68,7
torquata	Tolima	f	ansp	153432	Laguneta	3280	Colombia	38,9	41,5	43,2	1,7	73,3
torquata	Tolima	f	ansp	153431	Laguneta	2300	Colombia	35,6	41,2	40,9	-0,3	71,1

Table 17. List of the revised specimens of *Coeligena torquata*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
torquata	Monchique	m	ansp	144743	San Antonio, Cauca	2500	Colombia	39,6	40,1	47,6	7,5	78,4
torquata	Monchique	m	ansp	144741	San Antonio, Cauca	2300	Colombia	37,7	41,1	48,3	7,2	80,2
torquata	Monchique	m	ansp	144742	San Antonio, Cauca	2000	Colombia	37,9	44,1	48,2	4,1	80,4
torquata	Monchique	m	amnh	109437	La Florida, W. of Popayán, Cauca	2520	Colombia	37,5	43,1	45,7	2,6	
torquata	Monchique	m	amnh	109438	La Florida, W. of Popayán, Cauca	2520	Colombia		41,9	47,7	5,8	71,2
torquata	Monchique	m	fmnh	226511	Cerro Munchique, Cauca	2500	Colombia	38,8	43,1	46,9	3,8	78,8
torquata	Monchique	m	fmnh	226510	Cerro Munchique, Cauca	2500	Colombia	40,8	42,6	48,4	5,8	77,8
torquata	Monchique	m	fmnh	226512	Cerro Munchique, Cauca	2500	Colombia	39,8	43,6	47,7	4,1	79,8
torquata	Monchique	m	amnh	109444	Cerro Munchique, Cauca	2730	Colombia	38,9	41,8	45,4	3,6	73,8
torquata	Monchique	m	nmnh	446062	Cerro Munchiquito, Cauca	2460	Colombia	40,9	42,3	45,8	3,5	77,0
torquata	Monchique	m	nmnh	446061	Cerro Munchiquito, Cauca	2460	Colombia	38,2	40,5	49,0	8,5	79,0
torquata	Monchique	m	ansp	142561	El Tambo, Munchique, Cauca	2460	Colombia	38,6	43,0	48,0	5,0	78,7
torquata	Monchique	m	ansp	142562	El Tambo, Munchique, Cauca	2460	Colombia		43,6	49,3	5,7	76,7
torquata	Monchique	m	ansp	142560	El Tambo, Munchique, Cauca	2260	Colombia	38,7	45,6	51,1	5,5	84,2
torquata	Monchique	m	ansp	142563	El Tambo, Munchique, Cauca	2160	Colombia	38,6	42,3	49,8	7,5	79,1
torquata	Monchique	f	fmnh	226513	Cerro Munchique, Cauca	2500	Colombia	39,9	40,3	39,7	-0,6	72,3
torquata	Monchique	f	nmnh	446059	Cerro Munchiquito, Cauca	2780	Colombia	42,0	39,1	41,3	2,2	
torquata	Monchique	f	nmnh	255925	Cerro Munchiquito, Cauca	2730	Colombia		40,2	41,1	0,9	73,4
torquata	Monchique	f	amnh	109439	Cocal, W. Popayán, Cauca	2500	Colombia		38,4	42,5	4,1	71,3
torquata	Monchique	f	amnh	109441	Coast Range W. of Popayán, Cauca	3390	Colombia	40,5		40,7		70,7
torquata	Monchique	f	amnh	109442	Coast Range W. of Popayán, Cauca	3400	Colombia	42,3		44,0		74,8
torquata	Monchique	f	ansp	144740	El Tambo, Munchique, Cauca	2360	Colombia	40,6	40,6	41,5	0,9	71,3
torquata	Monchique	f	ansp	142564	El Tambo, Munchique, Cauca	2160	Colombia		39,8	41,4	1,6	74,3
torquata	Monchique	f	ansp	142565	El Tambo, Munchique, Cauca	2160	Colombia	40,4		40,6		72,2
torquata	Monchique	f	ansp	142566	El Tambo, Munchique, Cauca	1640	Colombia	38,1	38,1	42,7	4,6	73,7
torquata	Moscopan	m	nmnh	446069	Tijeras (Moscopan), Cauca	2750	Colombia	37,2	38,4			78,4
torquata	Moscopan	m	nmnh	446067	Tijeras (Moscopan), Cauca	2750	Colombia	38,7		47,1		79,3
torquata	Moscopan	m	nmnh	446063	Tijeras (Moscopan), Cauca	2750	Colombia	38,5	39,6			77,9
torquata	Moscopan	m	nmnh	446065	Tijeras (Moscopan), Cauca	2750	Colombia	36,7	44,2	50,5	6,3	81,0
torquata	Moscopan	m	nmnh	389230	Moscopan, Cauca	2300	Colombia	38,7	40,5	47,7	7,2	73,6
torquata	Moscopan	m	nmnh	389229	Moscopan, Cauca	2300	Colombia	38,4	43,4	47,8	4,4	75,7
torquata	Moscopan	m	ansp	156057	Buena Vista, Huila	2300	Colombia	37,4	39,1	46,1	7,0	75,0
torquata	Moscopan	f	nmnh	446064	Tijeras (Moscopan), Cauca	2750	Colombia	38,3	41,8	42,1	0,3	71,4
torquata	Moscopan	f	nmnh	446066	Tijeras (Moscopan), Cauca	2750	Colombia	38,8	39,9	40,9	1,0	69,0
torquata	Moscopan	f	nmnh	389231	Moscopan, Cauca	2300	Colombia	39,5	38,2	41,4	3,2	69,4
torquata	Llorente	m	fmnh	288026	Llorente, Nariño	1700	Colombia	37,6	43,2	46,5	3,3	76,7
torquata	Llorente	m	fmnh	288030	Llorente, Nariño	1700	Colombia	39,9	42,0	46,4	4,4	77,9
torquata	Llorente	m	fmnh	288023	Llorente, Nariño	1700	Colombia	39,4	41,2	45,2	4,0	74,3
torquata	Llorente	m	ansp	164778	Cordillera Pax		Colombia	38,9	42,7	45,9	3,2	79,8
torquata	Llorente	m	ansp	164779	Cordillera Pax		Colombia	39,2	41,6	48,2	6,6	81,6
torquata	Llorente	m	ansp	164780	Cordillera Pax		Colombia	39,9	41,6	46,3	4,7	79,6
torquata	Llorente	m	ansp	164783	Cordillera Pax		Colombia	41,8	44,4	47,5	3,1	79,0
torquata	Llorente	m	ansp	164783	Cordillera Pax		Colombia	39,7	42,3	46,2	3,9	80,1
torquata	Llorente	m	ansp	164784	Cordillera Pax		Colombia	39,6	41,5	47,8	6,3	78,7
torquata	Llorente	f	ansp	164785	Cordillera Pax		Colombia	43,1		41,9		73,9

Table 17. List of the revised specimens of *Coeligena torquata*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
torquata	Llorente	f	ansp	164786	Cordillera Pax		Colombia	42,1	40,9	40,5	-0,4	72,4
torquata	Llorente	f	ansp	164788	Cordillera Pax		Colombia	40,5	40,5	40,4	-0,1	73,4
torquata	Llorente	f	ansp	164789	Cordillera Pax		Colombia	39,9	41,4	41,9	0,5	71,4
torquata	Llorente	f	ansp	164790	Cordillera Pax		Colombia	40,1	39,8	41,8	2,0	74,0
torquata	Llorente	f	fmnh	288025	Llorente, Nariño	1700	Colombia	40,3		41,1		69,8
torquata	Llorente	f	fmnh	288027	Llorente, Nariño	1700	Colombia	42,5	40,9	41,7	0,8	69,7
torquata	Llorente	f	fmnh	288024	Llorente, Nariño	1700	Colombia	40,6	41,0	41,9	0,9	72,3
torquata	East Pichincha	m	zfmk	8619	Oyacachi	2500	Ecuador	37,9	45,6	49,5	3,9	79,3
torquata	East Pichincha	m	zfmk	8620	Oyacachi	2500	Ecuador	40,0	42,7	47,1	4,4	79,1
torquata	East Pichincha	m	nmnh	173736	lower W side of Pichincha		Ecuador	38,6	39,7	45,6	5,9	75,3
torquata	East Pichincha	m	zfmk	8617	Bellow Papallacta	3149	Ecuador	39,4	42,1	46,5	4,4	77,6
torquata	East Pichincha	m	amnh	180040	Papallacta Abajo, Napo		Ecuador	40,3	40,0	44,3	4,3	76,4
torquata	East Pichincha	m	mhnp		Papallacta, Baños		Ecuador	37,8	42,3	47,4	5,1	79,9
torquata	East Pichincha	m	mcz	298343	Cuyujúa, Napo	2400	Ecuador	37,7	42,6	48,3	5,7	78,4
torquata	East Pichincha	m	amnh	247234	Cuyujúa, Napo	2400	Ecuador	39,2	43,9	48,5	4,6	79,0
torquata	East Pichincha	m	amnh	247333	Cuyujúa, Napo	2400	Ecuador	40,5	43,9	48,9	5,0	81,6
torquata	East Pichincha	m	mhnp		Maspa	2600	Ecuador	39,1	43,5	48,3	4,8	76,7
torquata	East Pichincha	m	mhnp		Baeza	3756	Ecuador	37,9		45,7		78,1
torquata	East Pichincha	m	nmnh	173724	Baeza	1375	Ecuador	38,1	43,1	45,4	2,3	78,5
torquata	East Pichincha	m	nmnh	173725	Baeza	1375	Ecuador	39,3	41,6	48,1	6,5	79,5
torquata	East Pichincha	m	nmnh	173726	Baeza	1375	Ecuador	38,5	42,3	44,9	2,6	83,9
torquata	East Pichincha	m	nmnh	173727	Baeza	1375	Ecuador	36,9	44,4	48,5	4,1	79,5
torquata	East Pichincha	m	mhnp		Baeza		Ecuador	39,3	43,2	49,7	6,5	79,2
torquata	East Pichincha	m	amnh	175953	Baeza Arriba, Napo	1375	Ecuador	38,8	41,0	44,9	3,9	78,9
torquata	East Pichincha	m	amnh	185096	Sumaco Arriba		Ecuador	39,5	41,2	46,1	4,9	78,9
torquata	East Pichincha	m	amnh	185100	Sumaco Arriba		Ecuador	39,6	37,7	43,3	5,6	73,2
torquata	East Pichincha	m	amnh	185101	Sumaco Arriba		Ecuador	40,0	43,5	48,1	4,6	81,2
torquata	East Pichincha	m	amnh	185099	Sumaco Arriba		Ecuador	39,8	45,8	49,5	3,7	80,0
torquata	East Pichincha	m	amnh	185097	Sumaco Arriba		Ecuador	38,0	42,2	45,1	2,9	78,8
torquata	East Pichincha	m	ansp	185223	Huacamayo ridge, ca 8 km S Cosanga, Napo	2200	Ecuador	38,4	42,4	47,6	5,2	76,4
torquata	East Pichincha	m	ansp	181010	W slope, near road betw Maldonado & Tulcán along Río La Plata, Carchi	2525	Ecuador	41,0	42,4	48,7	6,3	76,4
torquata	East Pichincha	m	ansp	181008	W slope, near road betw Maldonado & Tulcán along Río La Plata, Carchi	2525	Ecuador	39,2	42,4	48,2	5,8	75,6
torquata	East Pichincha	m	ansp	181009	W slope, near road betw Maldonado & Tulcán along Río La Plata, Carchi	2525	Ecuador	37,0	39,4	47,1	7,7	74,3
torquata	East Pichincha	m	ansp	181011	W slope, near road betw Maldonado & Tulcán along Río La Plata, Carchi	2525	Ecuador	39,7	39,1	47,2	8,1	75,4
torquata	East Pichincha	f	zfmk	8612	Oyacachi	2500	Ecuador	40,9	36,2	39,4	3,2	71,8
torquata	East Pichincha	f	mhnp		Maspa	2600	Ecuador	39,5	41,8	41,2	-0,6	71,4
torquata	East Pichincha	f	nmnh	173721	Baeza	1375	Ecuador	41,0	40,9	41,2	0,3	73,9
torquata	East Pichincha	f	nmnh	173728	Baeza	1375	Ecuador	40,1	40,0	40,5	0,5	71,9
torquata	East Pichincha	f	amnh	175956	Baeza Arriba, Napo	1375	Ecuador	41,0	40,9	41,5	0,6	71,1
torquata	East Pichincha	f	amnh	175955	Baeza Arriba, Napo	1375	Ecuador	49,9	41,8	42,1	0,3	71,4
torquata	East Pichincha	f	zfmk	8618	Baeza, Orient Ecuador	1525	Ecuador	40,4	38,4	41,8	3,4	71,0
torquata	East Pichincha	f	amnh	185102	Sumaco Arriba		Ecuador	40,2		40,9		75,3
torquata	East Pichincha	f	amnh	185103	Sumaco Arriba		Ecuador	41,2	40,7	41,8	1,1	69,7
torquata	East Pichincha	f	ansp	185225	Huacamayo ridge, ca 8 km S Cosanga, Napo	2200	Ecuador	40,7	37,1	38,3	1,2	72,2
torquata	East Pichincha	f	ansp	185224	Huacamayo ridge, ca 8 km S Cosanga, Napo	2150	Ecuador	38,1	40,9	41,7	0,8	69,0

Table 17. List of the revised specimens of *Coeligena torquata*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
torquata	East Pichincha	f	ansp	181013	W slope, near road betw Maldonado & Tulcán along Río La Plata, Carchi	2525	Ecuador	41,5	37,2	41,4	4,2	67,7
torquata	East Pichincha	f	ansp	181012	W slope, near road betw Maldonado & Tulcán along Río La Plata, Carchi	2525	Ecuador	40,8	39,9	42,0	2,1	68,5
torquata	Tungurahua	m	amnh	37560	Río Napo, Napo		Ecuador	39,8	39,6	40,4	0,8	74,8
torquata	Tungurahua	m	amnh	482850	Ambato, Tungurahua	2600	Ecuador	37,5	42,9	44,1	1,2	75,5
torquata	Tungurahua	m	amnh	35538	Ambato, Tungurahua	2600	Ecuador	39,4	41,6	43,5	1,9	69,2
torquata	Tungurahua	m	amnh	35537	Ambato, Tungurahua	2600	Ecuador	37,9	44,2	44,9	0,7	74,8
torquata	Tungurahua	m	nmw	92361	Baños, Río Pastaza, Tungurahua	1820	Ecuador	37,2	43,9	45,0	1,1	75,2
torquata	Tungurahua	m	nmw	92362	Baños, Río Pastaza, Tungurahua	1820	Ecuador	36,8	42,0	45,3	3,3	74,0
torquata	Tungurahua	m	ansp	145518	Baños, Tungurahua	2200	Ecuador	36,8	41,1	44,1	3,0	76,9
torquata	Tungurahua	m	ansp	145519	Baños, Tungurahua	2200	Ecuador	38,2	41,3	46,6	5,3	76,6
torquata	Tungurahua	m	fmnh	372422	Rantún, Tungurahua		Ecuador	40,0	40,3	45,9	5,6	68,9
torquata	Tungurahua	m	fmnh	99465	Mera, Pastaza	1140	Ecuador	37,2	38,8	44,5	5,7	75,2
torquata	Tungurahua	f	fmnh	372423	Rantún, Tungurahua		Ecuador	39,4	40,4	41,1	0,7	71,8
torquata	Tungurahua	f	nmw	42702	Napo Fluss, Oberlauf		Ecuador	37,0	39,8	41,4	1,6	73,5
torquata	Morona	m	amnh	180940	Zuña, Río Upano, Morona-Santiago	2300	Ecuador	37,8	44,2	47,3	3,1	79,2
torquata	Morona	m	zmk		San Vicente, between Gualaceo and General L. Plaza Guiérrez, Morona-Sa	2700	Ecuador	42,5	43,4	47,1	3,7	79,9
torquata	Zamora	m	ansp	186099	Above Chinapinza, Zamora-Chinchipe	1950	Ecuador	38,2	44,0	50,4	6,4	77,0
torquata	Zamora	m	amnh	129476	Loja, Loja	2300	Ecuador		45,2	48,7	3,5	79,4
torquata	Zamora	m	mhnp		Zamora Huaico, Loja	2800	Ecuador	40,7	46,4	52,2	5,8	81,8
torquata	Zamora	m	mhnp		Vía Zamora, Loja		Ecuador	39,4	42,3	47,6	5,3	80,6
torquata	Zamora	m	mhnp		Vía Zamora, Loja		Ecuador	37,7	41,2	44,5	3,3	78,1
torquata	Zamora	m	ansp	185226	N Río Isimanchí, ca 6 km NW San Andrés, Zamora-Chichipe	2250	Ecuador	38,2	43,5	49,2	5,7	79,7
torquata	Zamora	f	ansp	185227	N Río Isimanchí, ca 6 km NW San Andrés, Zamora-Chichipe	2250	Ecuador	42,2	42,0	42,8	0,8	69,6
torquata	Zamora	f	amnh	181212	Chaupe, Cajamarca	2000	Peru	40,0	40,4	42,9	2,5	70,5

Table 18. List of the revised specimens of *Coeligena conradii*

POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
Merida	m	amnh	482836	Los Conejos, Mérida	4000	Venezuela	36,8	37,9	44,7	6,8	78,8
Merida	m	cop	297	Los Conejos, Mérida	3000	Venezuela	37,8	36,3	44,5	8,2	77,7
Merida	m	cop	295	Los Conejos, Mérida	3000	Venezuela	38,3	37,8	44,8	7,0	75,0
Merida	m	fmnh	46192	Los Conejos, Mérida	3000	Venezuela	37,0	36,6	45,3	8,7	78,9
Merida	m	cop	293	Páramo de La Culata	3000	Venezuela	39,1	38,0	45,4	7,4	77,7
Merida	m	cop	299	Páramo de La Culata	3000	Venezuela	36,6	35,6	44,4	8,8	76,5
Merida	m	cop	298	Páramo de La Culata	3000	Venezuela	36,9	35,6	46,3	10,7	78,1
Merida	m	cop	37327	Páramo de La Culata	3000	Venezuela	38,9	38,4	46,1	7,7	79,5
Merida	m	cop	37326	Páramo de La Culata	3000	Venezuela	37,2	36,5	47,1	10,6	77,2
Merida	m	fmnh	46186	Páramo de La Culata	4400	Venezuela	36,6	37,5	43,9	6,4	77,2
Merida	m	amnh	482831	Páramo de La Culata	4000	Venezuela	36,3	37,4	44,2	6,8	77,8
Merida	m	amnh	482829	Páramo de La Culata	4000	Venezuela	36,9	36,9	41,9	5,0	70,8
Merida	m	amnh	100530	Páramo de La Culata	4000	Venezuela	36,6	36,8	43,3	6,5	73,3
Merida	m	amnh	482827	Páramo de La Culata	4000	Venezuela	38,0	38,7	46,3	7,6	79,5
Merida	m	amnh	482830	Páramo de La Culata	4000	Venezuela	36,5	37,1	44,5	7,4	76,2
Merida	m	amnh	482826	Páramo de La Culata	4000	Venezuela	37,5	35,9	44,3	8,4	74,7
Merida	m	zfmk	8596	Páramo de La Culata	4000	Venezuela	35,5	38,0	45,4	7,4	74,7
Merida	m	zfmk	8593	Páramo de La Culata	4000	Venezuela	37,1	37,4	44,9	7,5	76,2
Merida	m	zfmk	8594	Páramo de La Culata	4000	Venezuela	37,9	38,1	44,4	6,3	79,2
Merida	m	zfmk	8597	Páramo de La Culata	4000	Venezuela	37,3	38,0	44,2	6,2	75,8
Merida	m	amnh	100533	Nevados, Mérida	3000	Venezuela	38,8	35,4	44,9	9,5	69,1
Merida	m	amnh	482787	Páramo de La Culata	3000	Venezuela	40,0	37,6	44,2	6,6	77,0
Merida	m	amnh	100528	Páramo de La Culata	3000	Venezuela	36,9	36,7	44,0	7,3	76,8
Merida	m	zfmk	8598	Páramo de La Culata	3000	Venezuela	38,8	38,8	45,7	6,9	79,3
Merida	m	zfmk	10287	Páramo de La Culata	3000	Venezuela	38,6	36,6	43,7	7,1	75,0
Merida	m	zfmk	8599	Páramo de La Culata	3000	Venezuela	36,6	36,1	44,5	8,4	78,1
Merida	m	mhnp		Páramo de La Culata	3000	Venezuela	38,2	37,8	45,1	7,3	77,8
Merida	m	nmw	92375	Páramo de La Culata	3000	Venezuela	37,2	37,9	45,1	7,2	75,5
Merida	m	zfmk		El Escorial, Mérida.	2500	Venezuela	36,3	37,1	43,5	6,4	73,8
Merida	m	zfmk		El Escorial, Mérida.	3000	Venezuela	37,5	36,9	43,3	6,4	77,4
Merida	m	cop	294	El Escorial, Mérida.	3000	Venezuela	36,8	35,9	44,8	8,9	75,1
Merida	m	cop	14349	El Valle, Mérida	2200	Venezuela			43,5		75,0
Merida	m	mhnp		Mérida, Mérida	1641	Venezuela	36,7	37,2	41,8	4,6	75,2
Merida	m	mhnp		Mérida, Mérida	1641	Venezuela	37,6	36,7	44,1	7,4	75,1
Merida	m	mhnp		Mérida, Mérida	1641	Venezuela	37,2	35,7	43,5	7,8	77,0
Merida	m	amnh	482845	Mérida, Mérida	1641	Venezuela	36,6	37,4	44,8	7,4	78,2
Merida	m	amnh	96321	Mérida, Mérida	1641	Venezuela	38,0	37,0	42,9	5,9	77,4
Merida	m	amnh	482841	Mérida, Mérida	1641	Venezuela	37,3	38,5	44,0	5,5	76,3
Merida	m	amnh	482842	Mérida, Mérida	1641	Venezuela	35,6	40,8	44,2	3,4	76,2
Merida	m	amnh	482843	Mérida, Mérida	1641	Venezuela	40,4	37,6	44,3	6,7	78,6

Table 18. List of the revised specimens of *Coeligena conradii*

POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
Merida	m	amnh	482848	Mérida, Mérida	1641	Venezuela	39,1	38,0	45,2	7,2	77,4
Merida	m	amnh	482846	Mérida, Mérida	1641	Venezuela	38,7	37,5	44,4	6,9	71,2
Merida	m	zfmk	8595	Mérida, Mérida	4000	Venezuela	37,8	36,7	46,1	9,4	79,3
Merida	m	zfmk	8600	Los Duraznos, Mérida	1500	Venezuela	37,4	36,3	43,1	6,8	74,1
Merida	m	nmw	92376	Nevados, Mérida	3000	Venezuela	36,5	37,5	44,8	7,3	77,2
Merida	m	nmw	20080	Nevados, Mérida	3000	Venezuela	37,0	37,0	44,0	7,0	75,0
Merida	m	fmnh	296957	Tambor, Mérida	3000	Venezuela	36,4	36,2	44,9	8,7	78,1
Merida	m	cop	292	Pinos, Mérida	3000	Venezuela	38,5	35,4	46,2	10,8	77,3
Merida	m	cop	1702	Pinos, Mérida	3000	Venezuela	39,2	34,7	43,8	9,1	
Merida	m	mhnp		La Hechicera, Mérida	3000	Venezuela	34,8	36,7	44,2	7,5	78,7
Merida	f	amnh	482840	Nevados, Mérida	3000	Venezuela	40,2	35,4	39,5	4,1	69,8
Merida	f	zfmk	8602	Páramo de La Culata	4000	Venezuela	39,2	35,8	38,7	2,9	68,9
Merida	f	zfmk	8603	Páramo de La Culata	3000	Venezuela	37,5	35,4	39,1	3,7	68,8
Merida	f	zfmk	8604	El Escorial, Mérida.	3000	Venezuela	38,1	36,7	41,1	4,4	69,2
Merida	f	cop	296	Los Conejos, Mérida	3000	Venezuela	38,9	35,0	42,2	7,2	76,8
Merida	f	cop	302	Los Conejos, Mérida	3000	Venezuela	41,4	34,4	41,0	6,6	70,3
Merida	f	amnh	100534	Nevados, Mérida	3000	Venezuela	38,3	37,2	40,3	3,1	70,6
Merida	f	fmnh	46195	Páramo de La Culata	4400	Venezuela	39,4	36,6	40,5	3,9	67,9
Merida	f	amnh	482834	Páramo de La Culata	4400	Venezuela	37,3	35,6	39,9	4,3	68,2
Merida	f	amnh	482833	Páramo de La Culata	4000	Venezuela	39,6	37,1	43,2	6,1	72,8
Merida	f	amnh	482832	Páramo de La Culata	4000	Venezuela	39,3	37,8	40,1	2,3	70,5
Merida	f	amnh	100527	Páramo de La Culata	3000	Venezuela	38,4	33,6	38,5	4,9	70,9
Merida	f	amnh	100531	Páramo de La Culata	3000	Venezuela	40,9	37,0	39,9	2,9	70,8
Merida	f	amnh	100532	Páramo de La Culata	3000	Venezuela	38,4	36,9	39,2	2,3	70,4
Merida	f	amnh	100529	Páramo de La Culata	3000	Venezuela	39,9	36,3	40,3	4,0	67,9
Merida	f	amnh	482835	Páramo de La Culata	3000	Venezuela	40,1	36,2	38,9	2,7	67,7
Merida	f	cop	300	Páramo de La Culata	3000	Venezuela	37,1	34,3			68,3
Merida	f	cop	14517	Quintero, Mérida	2800	Venezuela	39,7	35,7			71,0
Merida	f	amnh	482847	Mérida, Mérida	1641	Venezuela	39,3	33,7	39,8	6,1	69,7
Merida	f	amnh	482838	Mérida, Mérida	1641	Venezuela	39,3	36,3	38,3	2,0	68,8
Merida	f	amnh	482844	Mérida, Mérida	1641	Venezuela	37,7	37,1	39,6	2,5	70,2
Merida	f	amnh	482839	Mérida, Mérida	1641	Venezuela	40,6	34,6	39,0	4,4	71,6
Merida	f	amnh	37538	Mérida, Mérida	1641	Venezuela	37,8	39,3	43,7	4,4	72,7
Merida	f	zfmk	8601	M. Sierra, Mérida	3000	Venezuela	38,8	36,7	38,1	1,4	71,5
Merida	f	cop	14350	El Valle, Mérida	2200	Venezuela	38,8				
Merida	f	cks	8934	Nevados, Mérida		Venezuela	41,6	36,1	38,4	2,3	67,3

Table 19. List of the revised specimens of *Coeligena insectivora*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
margaretae	Amazonas	m	musm	4988	Cordillera Cotan E of La Peca, ridge W, Amazonas	2900	Peru	37,5	42,1	47,2	5,1	75,0
margaretae	Amazonas	m	amnh	234390	La Lejía, Chachapoyas	2950	Peru	42,1	43,0	50,9	7,9	78,3
margaretae	Amazonas	m	amnh	234395	La Lejía, Chachapoyas	2950	Peru	39,1	43,9	49,9	6,0	80,2
margaretae	Amazonas	m	amnh	234394	La Lejía, Chachapoyas	2950	Peru	40,7	44,0	45,8	1,8	78,6
margaretae	Amazonas	m	fmnh	47387	Uscho, Amazonas		Peru	36,1	42,0	48,2	6,2	79,0
margaretae	San Martin	m	musm	18517	ca. 28 km NE de Pataz, La Playa, San Martín	2640	Peru	38,5	43,4	49,4	6,0	79,3
margaretae	San Martin	m	musm	18521	ca. 32 km Pataz, Las Palmas, San Martín	2250	Peru	41,0	42,8	48,9	6,1	77,7
margaretae	San Martin	m	musm	18522	La Playa, San Martín	2945	Peru	40,7	42,7	49,4	6,7	78,3
margaretae	San Martin	f	musm	18519	La Playa, San Martín	2610	Peru	40,9	40,2	43,7	3,5	74,3
margaretae	San Martin	f	musm	18520	ca. 32 km Pataz, Las Palmas, San Martín	2195	Peru	43,1	40,8	43,3	2,5	70,0
margaretae	Utcubamba	m	musm	91808	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	39,7	40,9	46,9	6,0	81,0
margaretae	Utcubamba	m	musm	5994	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	38,8	40,6			77,4
margaretae	Utcubamba	m	musm	4857	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	39,4	42,2	48,4	6,2	79,1
margaretae	Utcubamba	m	musm	5995	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	39,2	41,4	48,4	7,0	79,7
margaretae	Utcubamba	f	musm	6555	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	43,9				73,1
margaretae	Utcubamba	f	musm	4835	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	42,7	41,3	43,0	1,7	69,9
margaretae	Utcubamba	f	musm	5989	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	41,8	40,9	44,4	3,5	73,6
margaretae	Utcubamba	f	musm	4851	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	43,1	40,0	43,7	3,7	71,7
margaretae	Utcubamba	f	musm	5991	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	43,0	40,5	41,6	1,1	73,6
margaretae	Utcubamba	f	musm	5987	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	45,0	41,7			72,7
margaretae	Utcubamba	f	musm	5988	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	43,4	40,4	43,6	3,2	71,1
margaretae	Utcubamba	f	musm	4834	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	42,9	41,1	40,1	-1,0	72,0
margaretae	Utcubamba	f	musm	6022	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	42,9				71,8
margaretae	Utcubamba	f	musm	6557	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	41,5	38,5	42,8	4,3	73,1
margaretae	Utcubamba	f	musm	4833	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	43,8	38,5	42,2	3,7	71,2
margaretae	Utcubamba	f	musm	4860	Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	42,8	40,4	41,6	1,2	71,3
insectivora	Carpish	m	amnh	798875	7 km road to NW Carpish Pass, Huánuco	2560	Peru	39,1	40,6	42,1	1,5	73,4
insectivora	Carpish	m	musm	19347	3 km E of Carpish Tunnel, Huánuco	2600	Peru	41,9	42,3	42,1	-0,2	69,6
insectivora	Carpish	m	musm	10611	ca. 8 km NW Cushi on trail to Chaglla, Playa Pampa, Pasco	2100	Peru	35,9	40,1	47,1	7,0	76,0
insectivora	Carpish	m	musm	17172	Cabecera Río San Alberto, Pque Nacional Yanachapa-Chemillén, Oxapampa,	2600	Peru	35,8	40,1	48,6	8,5	77,6
insectivora	Carpish	m	musm	17163	Cabecera Río San Alberto, Pque Nacional Yanachapa-Chemillén, Oxapampa,	2600	Peru	36,3	40,2	47,1	6,9	76,9
insectivora	Carpish	m	musm	17220	Cabecera Río San Alberto, Pque Nacional Yanachapa-Chemillén, Oxapampa,	2600	Peru	36,9	43,5	49,2	5,7	76,0
insectivora	Carpish	f	musm	17170	Cabecera Río San Alberto, Pque Nacional Yanachapa-Chemillén, Oxapampa,	2600	Peru	40,5	38,8	41,4	2,6	74,7
insectivora	Carpish	f	musm	17219	Cabecera Río San Alberto, Pque Nacional Yanachapa-Chemillén, Oxapampa,	2600	Peru	41,0	40,9	44,7	3,8	70,2
insectivora	Carpish	f	musm	17218	Cabecera Río San Alberto, Pque Nacional Yanachapa-Chemillén, Oxapampa,	2600	Peru	42,1	37,7	41,5	3,8	72,5
insectivora	Carpish	f	musm	17171	Cabecera Río San Alberto, Pque Nacional Yanachapa-Chemillén, Oxapampa,	2600	Peru	36,2	37,1	41,2	4,1	70,0
insectivora	Chilpes	m	amnh	169586	Chilpes, Junín	2225	Peru	40,3		38,6		66,0
insectivora	Chilpes	m	amnh	482883	Culumachay, Maraynioc, Junín	2950	Peru	35,4	41,4	49,2	7,8	78,0
insectivora	Ayacucho	m	amnh	820657	Estera Ruana, Ayacucho	1900	Peru	36,3	40,5	42,9	2,4	76,3
insectivora	Ayacucho	f	amnh	820658	Estera Ruana, Ayacucho	1900	Peru	37,6	38,6	40,2	1,6	70,4
insectivora	Ayacucho	f	amnh	820656	Estera Ruana, Ayacucho	1900	Peru	40,4	40,7	41,6	0,9	70,3
insectivora	Ayacucho	f	amnh	820659	Estera Ruana, Ayacucho	1900	Peru	42,1	40,5	41,8	1,3	73,3
insectivora	Ayacucho	f	amnh	820748	Yaraceyacu, Ayacucho	2600	Peru	41,5	38,9	41,8	2,9	74,1
eisenmanni	Vilcabamba	m	amnh	820055	14 km E. of Luisiana, Cordillera Vilcabamba	2050	Ecuador	39,4	42,3	46,7	4,4	75,4
eisenmanni	Vilcabamba	m	amnh	820410	Cordillera Vilcabamba, Cuzco	2640	Peru	37,4	41,6	47,7	6,1	77,6
eisenmanni	Vilcabamba	m	amnh	820410	Cordillera Vilcabamba, Cuzco	2200	Peru	37,9	43,3	49,4	6,1	73,2
eisenmanni	Vilcabamba	f	amnh	820476	Cordillera Vilcabamba, Cuzco	2830	Peru	41,8	42,8	42,2	-0,6	72,9
eisenmanni	Vilcabamba	f	amnh	820363	Cordillera Vilcabamba, Cuzco	2250	Peru	37,9	40,9	45,3	4,4	73,1
eisenmanni	Vilcabamba	f	amnh	820359	Cordillera Vilcabamba, Cuzco	2150	Peru	38,8	38,2	40,5	2,3	69,1

Table 20. List of the revised specimens of *Coeligena violifer*.

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
dichroura	Amazonas	m	amnh	235449	San Pedro, Chachapoyas		Peru	40,2	45,9	50,3	4,4	82,9
dichroura	Amazonas	m	musm	5088	Cordillera Colán, E La Peca, Amazonas	3200	Peru	41,1	46,8	54,8	8,0	84,7
dichroura	Amazonas	m	amnh	235448	San Pedro, Chachapoyas		Peru	40,2	43,1	47,3	4,2	80,4
dichroura	Amazonas	m	amnh	235447	San Pedro, Chachapoyas		Peru	39,2	46,2	50,2	4,0	79,8
dichroura	Amazonas	f	amnh	235450	San Pedro, Chachapoyas		Peru	44,0	42,0	46,3	4,3	75,0
dichroura	Amazonas	f	ansp	115557	Lejmabamba, Amazonas	2135	Peru	43,3	39,6	42,2	2,6	73,2
dichroura	San Martin	m	musm	18568	Pampa del Cuy, ca. 24 km NE de Pataz, San M	3280	Peru	41,6	45,1	53,5	8,4	83,6
dichroura	San Martin	m	musm	18574	Pampa del Cuy, ca. 24 km NE de Pataz, San M	3280	Peru	43,2		51,5		82,3
dichroura	San Martin	m	musm	18569	Pampa del Cuy, ca. 24 km NE de Pataz, San M	3280	Peru	42,4	45,0	55,4	10,4	83,6
dichroura	San Martin	f	musm	18570	Pampa del Cuy, ca. 24 km NE de Pataz, San M	3470	Peru	43,8	42,9			75,6
dichroura	San Martin	f	musm	18572	Pampa del Cuy, ca. 24 km NE de Pataz, San M	3310	Peru	44,0	40,3	45,2	4,9	74,0
dichroura	San Martin	f	musm	6528	Puerta del Monte, 30 km NE Los Alisos, San	3250	Peru	44,8	42,3	47,9	5,6	72,0
dichroura	San Martin	f	musm	18571	Puerta del Monte, 30 km NE Los Alisos, San	3250	Peru	45,8	42,5	47,1	4,6	75,7
dichroura	San Martin	f	musm	18573	Puerta del Monte, 30 km NE Los Alisos, San	3253	Peru	44,7		48,9		72,4
dichroura	San Martin	f	musm	5624	Pajatén, 40 km E de Pataz, San Martín	2800	Peru	44,6	41,9	46,4	4,5	76,1
dichroura	San Martin	f	musm	4836	Mashna, E Tayabamba, Libertad	3350	Peru	44,3	44,7	47,7	3,0	78,3
dichroura	San Martin	f	musm	6094	Mashna, E Tayabamba, Libertad	3350	Peru	45,2	44,9	49,0	4,1	75,5
dichroura	San Martin	f	musm	18575	Río La Playa, San Martín	2650	Peru	44,4	42,4	47,0	4,6	75,8
dichroura	Huanuco	m	fmnh	299080	Huancapata, Huánuco (Panao Region)	2950	Peru	40,1	45,3	51,9	6,6	79,4
dichroura	Huanuco	m	musm	4889	Side of Tunnel on Carretera Central, Carpis	2700	Peru	43,6	42,7			72,1
dichroura	Huanuco	m	fmnh	278319	Carpfish Ridge, Huánuco	2950	Peru	40,2	45,9	51,2	5,3	76,3
dichroura	Huanuco	m	fmnh	299081	Quilluacocha, Huánuco		Peru	38,5	44,1	52,4	8,3	81,1
dichroura	Huanuco	m	musm	7396	2 km NW Punta de Saria, Pozuzo Chagila trai	3100	Peru	39,9	44,5	54,0	9,5	77,3
dichroura	Huanuco	m	ansp	176400	Huancapata, Huánuco (Panao region)	2950	Peru	39,0	46,8	52,8	6,0	84,3
dichroura	Huanuco	m	ansp	176401	Huancapata, Huánuco (Panao region)	2950	Peru	40,3	42,9	53,0	10,1	76,4
dichroura	Huanuco	m	ansp	176402	Huancapata, Huánuco (Panao region)	2950	Peru	40,2	42,4	51,9	9,5	79,7
dichroura	Huanuco	m	musm	7002	Panao, Huancapata, Huánuco	3000	Peru	39,3	44,9	53,7	8,8	76,3
dichroura	Huanuco	m	musm	7001	Panao, Huancapata, Huánuco	3000	Peru	41,0	44,8	54,4	9,6	85,6
dichroura	Huanuco	m	musm	7000	Panao, Huancapata, Huánuco	3000	Peru	40,6	44,3	54,1	9,8	79,3
dichroura	Huanuco	m	fmnh	47695	Huánuco, Huánuco	3440	Peru	37,0	43,8	53,7	9,9	79,2
dichroura	Huanuco	f	fmnh	299082	Mascarrón, Huánuco (Acomayo Region)		Peru	43,7	42,6	48,3	5,7	74,8
dichroura	Huanuco	f	musm	10635	Base of Bosque Zapatogocha, above Acomayo	2700	Peru	43,2	44,3	47,7	3,4	75,1
dichroura	Huanuco	f	fmnh	296621	Quilluacocha, Huánuco	3280	Peru	42,8	41,9	45,5	3,6	73,5
dichroura	Huanuco	f	fmnh	283668	Bosque Taprag, Huánuco	2790	Peru	41,7	43,2	45,8	2,6	73,6
dichroura	Huanuco	f	musm	10632	Bosque Potrero, 14 km W Panao, Huánuco	3000	Peru	42,4	40,2	47,1	6,9	74,4
dichroura	Huanuco	f	musm	10609	Bosque Potrero, 14 km W Panao, Huánuco	3000	Peru	42,4	42,2	48,5	6,3	70,5
dichroura	Huanuco	f	ansp	176403	Cayumba, Huánuco (Panao region)	3110	Peru	39,5		48,7		72,4
dichroura	Huanuco	f	musm	2467	Caína, Huánuco	3316	Peru	39,9	40,1	45,6	5,5	75,3
dichroura	Junin	m	amnh	37546	Maraynioc, Junín		Peru	35,7	42,7	49,4	6,7	80,3
dichroura	Junin	m	ansp	103715	Aquimarco, Junín		Peru	41,0	45,3	50,0	4,7	83,0
dichroura	Junin	m	musm	2466	Rio Vitoc		Peru	38,4	43,1	52,7	9,6	
dichroura	Junin	m	ansp	92714	Huacapistana, Junín	3280	Peru	37,4	45,4	52,4	7,0	81,0
dichroura	Junin	m	ansp	92715	Huacapistana, Junín	3280	Peru	40,8	45,6	53,8	8,2	81,6
dichroura	Junin	m	musm	2465	Quebrada Tranca ca Palma, Junín	3030	Peru	40,8	42,0	49,7	7,7	82,1
dichroura	Junin	m	musm	10580	Chanchuleo, ca 8 km SE Calabaza, vía Satipo	3080	Peru	41,1	44,6	52,9	8,3	83,0

Table 20. List of the revised specimens of *Coeligena violifer*.

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
dichroura	Junin	m	musm	10633	Chanchuleo, ca 8 km SE Calabaza, vía Satipo	3080	Peru	37,9		51,2		
dichroura	Junin	m	musm	10583	Chanchuleo, ca 8 km SE Calabaza, vía Satipo	3080	Peru	40,1	42,7	51,4	8,7	
dichroura	Junin	m	musm	10584	Chanchuleo, ca 8 km SE Calabaza, vía Satipo	3080	Peru	42,2	45,0	53,6	8,6	81,0
dichroura	Junin	m	musm	10581	Chanchuleo, ca 8 km SE Calabaza, vía Satipo	3080	Peru	40,8	41,8	51,8	10,0	80,1
dichroura	Junin	m	musm	10582	Chanchuleo, ca 8 km SE Calabaza, vía Satipo	3080	Peru	41,4	41,7	51,2	9,5	79,6
dichroura	Junin	m	musm	10579	Chanchuleo, ca 8 km SE Calabaza, vía Satipo	3080	Peru	43,2	38,7	43,6	4,9	64,0
dichroura	Junin	m	nmnh	159783	Maraynioc	4260	Peru	40,7	43,0	51,7	8,7	81,3
dichroura	Junin	m	amnh	482802	Maraynioc, Junín	4350	Peru	40,7		54,0		83,4
dichroura	Junin	m	amnh	169581	Maraynioc, Junín	3604	Peru	42,4	46,1	53,5	7,4	84,3
dichroura	Junin	m	amnh	169580	Maraynioc, Junín	3604	Peru	41,7	43,8	52,4	8,6	81,9
dichroura	Junin	m	amnh	169583	Maraynioc, Junín	3604	Peru	40,2	46,0	53,8	7,8	83,1
dichroura	Junin	m	amnh	169582	Maraynioc, Junín	3604	Peru	40,3	44,1	53,5	9,4	80,0
dichroura	Junin	f	amnh	169585	Maraynioc, Junín	3604	Peru	42,5	39,6	43,8	4,2	70,5
dichroura	Junin	f	amnh	169584	Maraynioc, Junín	3604	Peru	38,9		44,3		77,1
albicaudata	Vilcabamba	m	amnh	820409	Cordillera Vilcabamba, Cuzco	2640	Peru	37,7	39,8	45,7	5,9	74,7
albicaudata	Vilcabamba	m	amnh	820540	Cordillera Vilcabamba, Cuzco	3525	Peru	36,3	41,8	50,0	8,2	77,7
albicaudata	Vilcabamba	m	amnh	820615	Cordillera Vilcabamba, Cuzco	3500	Peru	36,9	41,1	47,5	6,4	73,5
albicaudata	Vilcabamba	m	amnh	820537	Cordillera Vilcabamba, Cuzco	3300	Peru	38,2	42,5	50,3	7,8	77,2
albicaudata	Vilcabamba	m	amnh	820478	Cordillera Vilcabamba, Cuzco	2830	Peru	37,9	41,6	49,9	8,3	77,1
albicaudata	Vilcabamba	m	amnh	820500	Cordillera Vilcabamba, Cuzco	2830	Peru	37,2	40,7	47,5	6,8	73,8
albicaudata	Vilcabamba	m	amnh	820516	Cordillera Vilcabamba, Cuzco	2830	Peru	38,6	41,6	50,1	8,5	79,6
albicaudata	Vilcabamba	f	amnh	820355	Cordillera Vilcabamba, Cuzco	2250	Peru	33,6	41,3	42,8	1,5	70,3
albicaudata	Vilcabamba	f	amnh	820536	Cordillera Vilcabamba, Cuzco	3300	Peru	39,4	37,7	41,6	3,9	64,8
albicaudata	Vilcabamba	f	amnh	820538	Cordillera Vilcabamba, Cuzco	3190	Peru	40,5	40,1	41,9	1,8	70,0
albicaudata	Vilcabamba	f	amnh	820539	Cordillera Vilcabamba, Cuzco	3190	Peru	40,4		42,2		70,2
albicaudata	Vilcabamba	f	amnh	820477	Cordillera Vilcabamba, Cuzco	2830	Peru	42,7	38,2	40,6	2,4	68,0
albicaudata	Vilcabamba	f	amnh	820499	Cordillera Vilcabamba, Cuzco	2830	Peru	41,4	38,3	42,7	4,4	68,9
albicaudata	Vilcabamba	f	amnh	820408	Cordillera Vilcabamba, Cuzco	2640	Peru	41,0	39,8	41,5	1,7	70,2
albicaudata	Ayacucho	m	amnh	820743	Puncu, 30 km NE of Tambo, Ayacucho	3370	Peru	43,4	40,5	41,5	1,0	70,2
albicaudata	Ayacucho	m	amnh	820745	Puncu, 30 km NE of Tambo, Ayacucho	3370	Peru	43,7	44,8	44,2	-0,6	70,1
albicaudata	Ayacucho	m	amnh	820744	Puncu, 30 km NE of Tambo, Ayacucho	3370	Peru	44,3	39,4	40,2	0,8	68,8
albicaudata	Ayacucho	m	amnh	820447	Monte Uchuy, Ayacucho	3600	Peru	38,4	44,1	48,2	4,1	76,4
albicaudata	Ayacucho	m	amnh	820746	Monte Uchuy, Ayacucho	3600	Peru	39,4	42,7	48,8	6,1	77,5
osculans	Amplay	m	zmk		Cerro Turranmacco, NE of Nevada Amplay, C.	3500	Peru	35,5	42,0	48,0	6,0	74,9
osculans	Amplay	m	ansp	173716	Oconeque, Puno		Peru	37,9	39,1	51,7	12,6	76,8
osculans	Amplay	f	zmk		Bosque Ampay, N Abancay, Apurímac	3400	Peru	39,6	38,3	43,3	5,0	69,7
osculans	Amplay	f	musm	9507	Cerro Turranmacco, NE of Nevada Amplay, C.	3500	Peru	40,6	39,6	44,4	4,8	68,0
osculans	Amplay	f	musm	19346	Cerro Turranmacco, NE of Nevada Amplay, C.	3500	Peru	39,5	40,5	45,7	5,2	68,2
osculans	Cuzco	m	amnh	145051	Santa Rita, Urubamba cañón		Peru	37,2	42,7	50,2	7,5	77,0
osculans	Cuzco	m	zmk	64066	Machu Picchu, Cusco	2550	Peru		42,5	47,4	4,9	77,9
osculans	Cuzco	m	nmnh	273119	Torontoy	3500	Peru	41,0	41,8	50,0	8,2	73,5
osculans	Cuzco	f	fmnh	299538	Bosque San Luis, Cuzco	2950	Peru	42,5	41,9	45,4	3,5	72,4
osculans	Limbani	m	amnh	37543	Icachubata (Alto Río Ica)	3650	Peru	38,3	44,4	49,7	5,3	76,7
osculans	Limbani	m	amnh	37545	Icachubata (Alto Río Ica)	3650	Peru		41,9	51,7	9,8	76,2
osculans	Limbani	m	fmnh	311750	Pillahuata, km 126 , Cosñipata Hway, Cuzco	2510	Peru	38,7	43,6	50,6	7,0	75,1

Table 20. List of the revised specimens of *Coeligena violifer*.

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
osculans	Limbani	m	fmnh	311748	Pillahuata, km 126 , Cosñipata Hway, Cuzco	2510	Peru	38,4	41,5	49,0	7,5	77,1
osculans	Limbani	m	fmnh	311755	Pillahuata, km 126 , Cosñipata Hway, Cuzco	2500	Peru	39,2	36,8	43,8	7,0	69,8
osculans	Limbani	m	musm	20922	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	39,7	41,7	53,5	11,8	79,6
osculans	Limbani	m	musm	20926	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	40,2	41,7	50,7	9,0	76,5
osculans	Limbani	m	musm	20935	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	36,5	42,4	48,1	5,7	76,7
osculans	Limbani	m	musm	20927	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	39,2	40,1	48,5	8,4	73,2
osculans	Limbani	m	musm	13514	Pillahuata, km 126 , Cosñipata Hway, Cuzco	2510	Peru	38,8	39,9	50,2	10,3	74,4
osculans	Limbani	m	fmnh	311751	Pillahuata, km 126 , Cosñipata Hway, Cuzco	2500	Peru	37,8	41,0	49,7	8,7	73,2
osculans	Limbani	m	zmk	63137	Marcapata, Quispicanchis	3050	Peru	39,6	41,9			76,0
osculans	Limbani	m	fmnh	222196	Marcapa, Ccachubamba, Cuzco	2850	Peru	39,2	41,3	48,9	7,6	74,8
osculans	Limbani	m	amnh	422799	Marcapata, Cuzco	3500	Peru	38,7	39,1	45,9	6,8	73,6
osculans	Limbani	m	amnh	482800	Marcapata, Cuzco	3460	Peru	39,2	40,1	47,7	7,6	73,9
osculans	Limbani	m	amnh	482798	Marcapata, Cuzco	3560	Peru	37,2	41,8	48,2	6,4	76,6
osculans	Limbani	m	amnh	482796	Limbani, Carabaya	3100	Peru	39,8	41,8	50,5	8,7	76,6
osculans	Limbani	m	fmnh	46178	Limbani, Carabaya, Puno	2950	Peru	37,8	44,5	52,2	7,7	77,4
osculans	Limbani	m	musm	6244	Valcón, 5 km NNW Quiaca, Puno	3000	Peru	37,4	40,7	51,2	10,5	77,9
osculans	Limbani	f	musm	20934	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	43,5	41,5			69,3
osculans	Limbani	f	amnh	37544	Icachubata (Alto Río Ica)	3650	Peru		40,4	44,1	3,7	68,8
osculans	Limbani	f	musm	20937	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	43,1	39,6	43,2	3,6	69,5
osculans	Limbani	f	musm	20931	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	42,9	38,6	40,8	2,2	68,7
osculans	Limbani	f	musm	20942	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	41,5	40,1	44,5	4,4	68,0
osculans	Limbani	f	musm	20889	Localidad de Pillahuata, carretera a Pilcop	3000	Peru		37,9			69,1
osculans	Limbani	f	musm	20936	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	43,5	40,0	42,1	2,1	70,4
osculans	Limbani	f	musm	20933	Localidad de Pillahuata, carretera a Pilcop	3000	Peru	43,0	39,6	44,6	5,0	70,4
osculans	Limbani	f	musm	13511	Pillahuata, km 126 , Cosñipata Hway, Cuzco	2510	Peru	40,1	36,6	43,0	6,4	69,5
osculans	Limbani	f	fmnh	311756	Pillahuata, km 126 , Cosñipata Hway, Cuzco	2500	Peru	41,3	41,8	44,0	2,2	70,9
osculans	Limbani	f	amnh	482801	Marcapata, Cuzco	3560	Peru	42,2	40,0	45,1	5,1	68,0
osculans	Limbani	f	zfmk	8575	Limbani, Carabaya	2750	Peru	41,8	39,6	42,0	2,4	71,8
osculans	Limbani	f	amnh	482797	Limbani, Carabaya	3100	Peru	39,5	40,6	45,4	4,8	71,0
osculans	Limbani	f	fmnh	46177	Limbani, Carabaya, Puno	2950	Peru	41,9	38,3	43,0	4,7	64,5
violifer	La Paz	m	amnh	482794	Sillunticara	3280	Bolivia	37,7	44,1	50,2	6,1	75,8
violifer	La Paz	m	amnh	37540	Sillunticara	3280	Bolivia	39,0	41,9	49,6	7,7	76,0
violifer	La Paz	m	amnh	37541	Sillunticara	3280	Bolivia	40,3	42,8	52,2	9,4	76,4
violifer	La Paz	m	amnh	482795	Sillunticara	3280	Bolivia	38,3	38,9	52,5	13,6	75,6
violifer	La Paz	m	ansp	120900	Hichuloma, La Paz	3500	Bolivia	38,8	41,7	49,0	7,3	72,5
violifer	La Paz	m	ansp	120901	Hichuloma, La Paz	3500	Bolivia	38,6	40,6	49,8	9,2	74,1
violifer	La Paz	m	ansp	120902	Hichuloma, La Paz	3500	Bolivia	38,5	43,4	53,1	9,7	75,8
violifer	La Paz	m	ansp	120903	Hichuloma, La Paz	3500	Bolivia	37,7	42,0			
violifer	La Paz	m	ansp	120908	Hichuloma, La Paz	3500	Bolivia	38,4	43,7	49,9	6,2	75,8
violifer	La Paz	m	zmk		Tambo Pata, Yungas of Cochabamba	2900	Bolivia	35,9	40,5	47,4	6,9	77,6
violifer	La Paz	m	ansp	145225	Chorros, Cochabamba	3600	Bolivia	38,2	41,2	51,3	10,1	73,6
violifer	La Paz	m	amnh	482793	Cocapata	2200	Bolivia	37,1	42,0	48,3	6,3	76,3
violifer	Cochabamba	m	fmnh	110346	Incachaca, Cochabamba	2800	Bolivia	37,4	43,1	51,2	8,1	76,2
violifer	Cochabamba	m	fmnh	179441	Aduana, near Incachaca, Cochabamba	3100	Bolivia	36,6	41,8	50,5	8,7	73,6
violifer	Cochabamba	m	fmnh	293702	Santa Cruz, 28 km W Comarapa	2750	Bolivia	38,8	42,6	50,5	7,9	76,8

Table 20. List of the revised specimens of *Coeligena violifer*.

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
violifer	Cochabamba	m	zfmk	8574	Incachaca, Cochabamba	2800	Bolivia	37,1	40,3	43,3	3,0	68,2
violifer	Cochabamba	m	zfmk	8571	Incachaca, Cochabamba	2800	Bolivia	38,6	46,0	50,0	4,0	78,0
violifer	Cochabamba	m	zfmk	8569	Incachaca, Cochabamba	2800	Bolivia	36,1	43,8	55,9	12,1	
violifer	Cochabamba	m	zfmk	8572	Incachaca, Cochabamba	2800	Bolivia	36,2	42,7	47,8	5,1	78,3
violifer	Cochabamba	m	ansp	145224	Incachaca, Cochabamba	3280	Bolivia	35,2	45,2	53,1	7,9	77,6
violifer	Cochabamba	m	ansp	145222	Incachaca, Cochabamba	3280	Bolivia	36,5	41,4	53,1	11,7	76,9
violifer	Cochabamba	m	ansp	79090	Incachaca, Cochabamba	2500	Bolivia	37,3	43,4	54,8	11,4	80,2
violifer	Cochabamba	m	nmnh	173684	Ceja de Juno, Cochabamba	3000	Bolivia	37,4		51,6		76,2
violifer	Cochabamba	m	zfmk	8567	Ceja de Juno, Cochabamba	3000	Bolivia	38,3	45,1	50,9	5,8	78,8
violifer	Cochabamba	m	zfmk	8564	Ceja de Juno, Cochabamba	3000	Bolivia	37,5	43,6	50,0	6,4	69,4
violifer	Cochabamba	m	zfmk	8568	Ceja de Juno, Cochabamba	3000	Bolivia	38,3	44,5	51,7	7,2	75,2
violifer	Cochabamba	m	zfmk	8570	Ceja de Juno, Cochabamba	3000	Bolivia		43,5	50,1	6,6	79,3
violifer	Cochabamba	m	zfmk	8566	Ceja de Juno, Cochabamba	3000	Bolivia	37,0	41,7	47,6	5,9	74,2
violifer	Cochabamba	m	ansp	145226	San Cristobal, Cochabamba (near city of Coc	2920	Bolivia	38,7	41,8	51,4	9,6	76,1
violifer	Cochabamba	m	fmnh	179437	Aduana, near Incachaca, Cochabamba	3100	Bolivia	36,8	42,5	52,5	10,0	76,3
violifer	Cochabamba	m	amnh	823763	15 km N. Monte Punco, Totora, Cochabamba	1700	Bolivia	39,1	43,8	51,5	7,7	78,6
violifer	Cochabamba	m	amnh	823762	15 km N. Monte Punco, Totora, Cochabamba	1700	Bolivia	39,6	41,7	46,0	4,3	76,2
violifer	Cochabamba	m	amnh	823764	15 km N. Monte Punco, Totora, Cochabamba	1700	Bolivia	40,2	41,2	49,8	8,6	78,3
violifer	Cochabamba	m	fmnh	293703	Santa Cruz, 28 km W Comarapa	2750	Bolivia	38,2	43,8	52,3	8,5	75,6
violifer	Cochabamba	m	fmnh	293688	Santa Cruz, 28 km W Comarapa	2750	Bolivia	38,3	43,4	49,5	6,1	78,6
violifer	Cochabamba	m	fmnh	293704	Santa Cruz, 28 km W Comarapa	2750	Bolivia	38,3	41,2	48,7	7,5	76,2
violifer	Cochabamba	m	fmnh	293701	Santa Cruz, 28 km W Comarapa	2750	Bolivia	39,2	40,4	49,5	9,1	75,8
violifer	Cochabamba	m	fmnh	293698	Santa Cruz, 28 km W Comarapa	2750	Bolivia	37,3	43,2	50,6	7,4	77,1
violifer	Cochabamba	m	fmnh	293691	Santa Cruz, 28 km W Comarapa	2690	Bolivia	39,4	43,3	52,3	9,0	77,0
violifer	Cochabamba	m	fmnh	293692	Santa Cruz, 28 km W Comarapa	2690	Bolivia	38,4	40,8	47,8	7,0	76,7
violifer	Cochabamba	m	fmnh	293690	Santa Cruz, 28 km W Comarapa	2690	Bolivia	36,5	43,1	48,5	5,4	75,0
violifer	Cochabamba	m	fmnh	293689	Santa Cruz, 28 km W Comarapa	2690	Bolivia	39,0	42,1	49,9	7,8	73,3
violifer	Cochabamba	m	fmnh	293686	Santa Cruz, 28 km W Comarapa	2690	Bolivia	35,3	41,1	50,1	9,0	74,4
violifer	Cochabamba	m	fmnh	293687	Santa Cruz, 28 km W Comarapa	2690	Bolivia	37,2	41,9	48,4	6,5	75,0
violifer	Cochabamba	f	zfmk	8565	Incachaca, Cochabamba	2800	Bolivia	35,3	39,4	43,2	3,8	69,3
violifer	Cochabamba	f	zfmk	8573	Incachaca, Cochabamba	2800	Bolivia	40,6	39,3	45,2	5,9	70,1
violifer	Cochabamba	f	ansp	145223	Incachaca, Cochabamba	3280	Bolivia	41,6	40,6	44,6	4,0	71,7
violifer	Cochabamba	f	zfmk	81401	Cochabamba	1667	Bolivia	40,3	39,4	40,1	0,7	64,4
violifer	Cochabamba	f	fmnh	293693	Santa Cruz, 28 km W Comarapa	2690	Bolivia	41,5	40,4			67,8
violifer	Cochabamba	f	fmnh	293696	Santa Cruz, 28 km W Comarapa	2750	Bolivia	40,0	40,9	42,8	1,9	69,9

Table 21. List of the revised specimens of *Coeligena wilsoni*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
wilsoni	Pisones	f	ansp	157710	La Selva, Caldas	1970	Colombia	39,1	34,4	38,4	4,0	64,5
wilsoni	Pisones	f	icn	31142	Mistrato 10 km N, El Empalado	1720	Colombia	36,7	38,4	42,1	3,7	66,4
wilsoni	Pisones	f	icn	31161	8 km NW Gueguadas, Alto de Pisones		Colombia	37,0				66,4
wilsoni	Pisones	m	ansp	157708	La Selva, Caldas	1600	Colombia	35,3	38,1	44,9	6,8	70,9
wilsoni	Pisones	m	ansp	157709	La Selva, Caldas	2300	Colombia		37,5	44,3	6,8	69,2
wilsoni	Pisones	m	ansp	157705	La Selva, Caldas	1970	Colombia	36,7	37,6	44,5	6,9	74,7
wilsoni	Pisones	m	ansp	157706	La Selva, Caldas	1970	Colombia	34,1	37,8	42,9	5,1	67,6
wilsoni	El Tambo	f	ansp	137925	Rio Mechengue, El Tambo, Cauca	2000	Colombia	38,4	36,4	38,8	2,4	66,6
wilsoni	El Tambo	f	icn	25728	El Tambo, Charguayaco	1800	Colombia	37,4	35,1	40,9	5,8	66,0
wilsoni	El Tambo	m	icn	25769	El Tambo, Charguayaco	2400	Colombia	32,7	37,7	43,8	6,1	70,3
wilsoni	El Tambo	m	icn	29191	El Tambo, Huisitó, Cauca	500	Colombia	34,5	39,8	46,5	6,7	72,2
wilsoni	El Tambo	m	icn	32227	Almaguer, 2 km ENE El Barro	1420	Colombia	37,8	38,9			
ssp nov.	Nariño	f	ansp	170739	Ricaurte, Nariño	1280	Colombia			41,8		68,8
ssp nov.	Nariño	f	nmnh	389263	Ricaurte, Nariño	1000	Colombia		37,6	37,1	-0,5	67,8
ssp nov.	Nariño	f	ansp	181007	ca 4km SSW of Chical,S. side of San José de Rio B	1650	Ecuador	39,2	35,7	36,3	0,6	63,3
ssp nov.	Nariño	f	ansp	181002	ca 4km SSW of Chical,S. side of San José de Rio B	1650	Ecuador	38,4	34,8	37,2	2,4	65,0
ssp nov.	Nariño	f	icn	30409	Barbacoas, Buenavista Vereda Piedra Verde km 14,5	1000	Colombia	34,8	35,8	40,3	4,5	66,8
ssp nov.	Nariño	f	icn	30440	Barbacoas, Buenavista Vereda Piedra Verde km 14,5	1000	Colombia	37,9	35,5	40,1	4,6	71,0
ssp nov.	Nariño	f	icn	27280	Ricaurte, Nariño		Colombia	39,6	36,8	42,4	5,6	69,3
ssp nov.	Nariño	f	icn	7685	Ricaurte, Nariño		Colombia	38,3	37,0	39,4	2,4	66,9
ssp nov.	Nariño	f	ansp	170735	Ricaurte, Nariño	1280	Colombia	35,9	38,0	42,0	4,0	71,5
ssp nov.	Nariño	f	ansp	170737	Ricaurte, Nariño	1280	Colombia	36,4	37,5	43,3	5,8	74,2
ssp nov.	Nariño	m	icn	30334	Barbacoas, Buenavista Vereda Piedra Verde km 14,5	1140	Colombia	35,2	38,4	45,4	7,0	72,5
ssp nov.	Nariño	m	icn	30400	Barbacoas, Buenavista Vereda Piedra Verde km 14,5	1000	Colombia	34,9		43,1		74,5
ssp nov.	Nariño	m	icn	27293	La Planada, Ricaurte	2000	Colombia	35,7	35,2	46,7	11,5	72,5
ssp nov.	Nariño	m	icn	7686	Ricaurte, Nariño		Colombia	36,1	38,1	46,8	8,7	73,1
ssp nov.	Nariño	m	nmnh	389264	Ricaurte, Nariño	1000	Colombia	36,3	36,3			
ssp nov.	Nariño	m	nmnh	469511	Ricaurte, Nariño	2500	Colombia	37,2				71,9
ssp nov.	Nariño	m	ansp	170736	Ricaurte, Nariño	1280	Colombia	36,7	38,1	43,3	5,2	73,8
ssp nov.	Nariño	m	ansp	170734	Ricaurte, Nariño	1280	Colombia	33,7	37,2	44,9	7,7	73,4
ssp nov.	Nariño	m	ansp	170738	Ricaurte, Nariño	1280	Colombia	34,4	36,5	43,6	7,1	74,6
ssp nov.	Nariño	m	ansp	170740	Rio Peasbí, Mayasquer, Nariño	1570	Colombia	34,9	39,2	45,6	6,4	76,3
ssp nov.	Nariño	m	ansp	181005	ca 4km SSW of Chical,S. side of San José de Rio Blanco, Carchi	1650	Ecuador	39,7	37,8	44,4	6,6	74,5
ssp nov.	Nariño	m	ansp	181001	ca 4km SSW of Chical,S. side of San José de Rio Blanco, Carchi	1650	Ecuador	37,0	36,6	46,3	9,7	74,6
ssp nov.	Nariño	m	ansp	181003	ca 4km SSW of Chical,S. side of San José de Rio Blanco, Carchi	1650	Ecuador	34,9	38,5	43,6	5,1	68,1
ssp nov.	Nariño	m	ansp	181006	ca 4km SSW of Chical,S. side of San José de Rio Blanco, Carchi	1775	Ecuador	35,6	37,5	43,4	5,9	70,0
ssp nov.	Pichincha	f	amnh	124155	Gualea, Pichincha		Ecuador	36,4	37,5	38,3	0,8	68,9
ssp nov.	Pichincha	f	amnh	124153	Gualea, Pichincha		Ecuador	36,5	36,2	36,8	0,6	66,1
ssp nov.	Pichincha	f	zfmk	8664	Camino de Pachigal		Ecuador	37,1	34,8	35,4	0,6	66,0
ssp nov.	Pichincha	f	zfmk	8662	Camino de Pachigal		Ecuador	36,3	35,5	36,9	1,4	65,1
ssp nov.	Pichincha	f	zfmk	8665	Camino de Pachigal		Ecuador	35,8	36,4	37,9	1,5	64,8
ssp nov.	Pichincha	f	mhnp		Gualea,	1500	Ecuador	35,8	34,4	34,7	0,3	
ssp nov.	Pichincha	f	amnh	124154	Gualea, Pichincha		Ecuador	37,3	37,1	38,3	1,2	67,6
ssp nov.	Pichincha	f	amnh	124151	Gualea, Pichincha		Ecuador	35,8	36,4	35,9	-0,5	65,5
ssp nov.	Pichincha	f	zfmk	8670	Mindo-Gualea	1550	Ecuador	36,6	32,4	36,7	4,3	64,7
ssp nov.	Pichincha	f	zfmk	8669	Mindo-Gualea	1550	Ecuador	36,6	34,8	37,2	2,4	67,7
ssp nov.	Pichincha	f	zfmk	8668	Mindo-Gualea	1550	Ecuador	37,4	34,4	38,0	3,6	67,9

Table 21. List of the revised specimens of *Coeligena wilsoni*

SUBSPECIES	POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1_R5	WING_LENGTH
ssp nov.	Pichincha	f	zfmk	8663	Mindo-Gualea	1550	Ecuador	37,4	36,2	36,8	0,6	65,7
ssp nov.	Pichincha	f	ansp	180241	Mindo, Pichincha	1550	Ecuador	36,8	37,9	37,4	-0,5	66,4
ssp nov.	Pichincha	f	zfmk	81364	Quito (Mindo)	2818	Ecuador	37,2	36,0	37,3	1,3	64,2
ssp nov.	Pichincha	f	ansp	169818	San Domingo de Los Colorados	1000	Ecuador	37,0	36,7	37,9	1,2	68,4
ssp nov.	Pichincha	f	ansp	58908	San Domingo de Los Colorados	1000	Ecuador	37,7	37,6	39,6	2,0	67,5
ssp nov.	Pichincha	f	nmnh	173754	Milligalli	1800	Ecuador	36,7	35,1	36,7	1,6	66,1
ssp nov.	Pichincha	f	nmnh	173757	Milligalli	1800	Ecuador	34,6	37,1	43,2	6,1	74,2
ssp nov.	Pichincha	f	ansp	58909	San Domingo de Los Colorados	1000	Ecuador	37,3	34,8	37,5	2,7	66,3
ssp nov.	Pichincha	m	zfmk	8660	Camino de Pachigal		Ecuador	35,4	38,4	43,0	4,6	72,3
ssp nov.	Pichincha	m	zfmk	8659	Camino de Pachigal		Ecuador	35,7	37,4	44,1	6,7	74,0
ssp nov.	Pichincha	m	mcz	96023	Pechegal (Pachigal?)		Ecuador		36,1	42,2	6,1	67,6
ssp nov.	Pichincha	m	mcz	104614	Nanegal	1400	Ecuador	35,3	37,2	42,1	4,9	67,4
ssp nov.	Pichincha	m	amnh	154774	Gualea, Pichincha	1200-1825	Ecuador	35,2	36,0	38,6	2,6	71,0
ssp nov.	Pichincha	m	nmw	19047	Gualea, W Ecuador	1500	Ecuador	37,5	36,4	36,3	-0,1	65,7
ssp nov.	Pichincha	m	zfmk	8671	Mindo-Gualea	1550	Ecuador	36,2	38,2	43,6	5,4	73,3
ssp nov.	Pichincha	m	zfmk	8658	Mindo-Gualea	1550	Ecuador	35,2	36,9	40,0	3,1	69,9
ssp nov.	Pichincha	m	zfmk	8666	Mindo-Gualea	1550	Ecuador	35,1	36,9	41,1	4,2	71,3
ssp nov.	Pichincha	m	zfmk	B1.I.35.k.α	Mindo-Gualea	1550	Ecuador	36,1	37,0	40,1	3,1	69,8
ssp nov.	Pichincha	m	amnh	124150	Gualea, Pichincha	1200-1825	Ecuador	34,5	37,5	37,4	-0,1	67,5
ssp nov.	Pichincha	m	zfmk	8667	Mindo	1260	Ecuador	35,2	39,6	44,0	4,4	73,2
ssp nov.	Pichincha	m	ansp	180240	Mindo, Pichincha	1550	Ecuador	36,4	36,9	41,0	4,1	67,4
ssp nov.	Pichincha	m	ansp	58907	San Domingo de Los Colorados	1000	Ecuador	33,9	34,7	39,6	4,9	70,1
ssp nov.	Pichincha	m	nmnh	173752	Millagalli	1800	Ecuador	34,2	38,1	38,3	0,2	69,0
ssp nov.	Pichincha	m	nmnh	173755	Millagalli	1800	Ecuador	36,6	35,2	38,6	3,4	68,5
ssp nov.	Pichincha	m	nmnh	173756	Millagalli	1800	Ecuador	35,0	36,5	41,0	4,5	69,7
ssp nov.	Pichincha	m	nmnh	173753	Milligalli	1800	Ecuador	35,8	37,4	40,2	2,8	68,3
ssp nov.	El Oro	f	amnh	482935	Río Pescado, nerar Naranjal	1000	Ecuador	34,1	33,5	34,1	0,6	61,5
ssp nov.	El Oro	f	amnh	166884	El Chiral, Santa Rosa-Zaruma trail, Prov. del Oro	1750	Ecuador	36,6	35,3	34,4	-0,9	64,8
ssp nov.	El Oro	f	amnh	166888	El Chiral, Santa Rosa-Zaruma trail, Prov. del Oro	1750	Ecuador	35,5	34,8	33,6	-1,2	62,2
ssp nov.	El Oro	f	amnh	166886	El Chiral, Santa Rosa-Zaruma trail, Prov. del Oro	1750	Ecuador	33,0	34,8	35,2	0,4	64,6
ssp nov.	El Oro	f	amnh	166885	El Chiral, Santa Rosa-Zaruma trail, Prov. del Oro	1750	Ecuador	32,9	35,3	36,5	1,2	62,3
ssp nov.	El Oro	f	ansp	177555	ca 9,5km road West of Piñas, Prov. El Oro	900	Ecuador	33,3	33,5	37,2	3,7	63,4
ssp nov.	El Oro	f	amnh	166891	Punta Santa Ana, Portovelo trail, Prov. del Oro		Ecuador	34,0	35,1	35,7	0,6	61,8
ssp nov.	El Oro	m	ansp	58915	Junction of Chanchán and Chiguancay Rivers (Chanchán & Chiguancay)	820	Ecuador	32,8	35,3	41,2	5,9	67,4
ssp nov.	El Oro	m	ansp	58913	Junction of Chanchán and Chiquancay Rivers	820	Ecuador	34,9	36,5	43,3	6,8	71,5
ssp nov.	El Oro	m	amnh	482937	Río Pescado (Nov. Zool. I. p.47), Guayas?	500-3000ft	Ecuador	34,0	36,1	39,7	3,6	67,2
ssp nov.	El Oro	m	amnh	482936	Río Pescado (Nov. Zool. I. p.47), Guayas?	500-3000ft	Ecuador	33,9	37,4	42,9	5,5	69,2
ssp nov.	El Oro	m	amnh	482938	Río Pescado (Nov. Zool. I. p.47), Guayas?	500-3000ft	Ecuador	32,9	35,1	39,4	4,3	65,3
ssp nov.	El Oro	m	amnh	166887	El Chiral, Santa Rosa-Zaruma trail, Prov. del Oro	1750	Ecuador	34,1	38,4	42,8	4,4	69,2
ssp nov.	El Oro	m	amnh	166889	El Chiral, Santa Rosa-Zaruma trail, Prov. del Oro	1750	Ecuador	30,8	38,5	41,9	3,4	69,8
ssp nov.	El Oro	m	amnh	166890	El Chiral, Santa Rosa-Zaruma trail, Prov. del Oro	1750	Ecuador	25,1	37,2	39,5	2,3	66,8
ssp nov.	El Oro	m	ansp	177552	ca 9,5km road West of Piñas, Prov. El Oro	900	Ecuador	32,4	35,7	43,6	7,9	66,2
ssp nov.	El Oro	m	ansp	177553	ca 9,5km road West of Piñas, Prov. El Oro	900	Ecuador	36,1	36,0	43,8	7,8	64,9
ssp nov.	El Oro	m	ansp	177554	ca 9,5km road West of Piñas, Prov. El Oro	900	Ecuador	33,4	37,8	44,8	7,0	69,4

Table 22. List of the revised specimens of *Coeligena* (=*Ensifera*) *ensifera*

POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1-R5	WING-LENGTH
Merida	f	amnh	483004	El Escorial, Mérida	2500	Venezuela	114,3	34,9	56,7	21,8	78,2
Merida	f	amnh	483003	El Escorial, Mérida	2500	Venezuela	114,9	36,8	54,4	17,6	77,7
Merida	f	zfmk	8739	El Escorial, Mérida	2500	Venezuela	107,6	36,3	47,7	11,4	68,9
Merida	f	zfmk	8742	El Escorial, Mérida	2500	Venezuela	114,2	36,5	48,7	12,2	77,6
Merida	f	zfmk	8741	El Escorial, Mérida	2500	Venezuela	110,3	36,4	46,8	10,4	77,0
Merida	f	zfmk	8740	El Escorial, Mérida	2500	Venezuela	113,9	39,3	47,7	8,4	75,2
Merida	f	amnh	483005	La Culata, Mérida	4000	Venezuela	110,0	37,0	49,5	12,5	73,6
Merida	m	amnh	100537	El Escorial, Mérida	3000	Venezuela	106,4	36,6	54,1	17,5	76,2
Merida	m	zfmk	8725	El Escorial, Mérida	2500	Venezuela	103,0	35,8	46,2	10,4	75,2
Merida	m	zfmk		El Escorial, Mérida	2500	Venezuela		38,4	47,6	9,2	75,3
Merida	m	zfmk	8727	El Escorial, Mérida	2500	Venezuela	101,9	34,1	57,5	23,4	77,2
Merida	m	zfmk	8728	El Escorial, Mérida	2500	Venezuela	103,3	34,5	59,2	24,7	78,0
Merida	m	zfmk	8726	El Escorial, Mérida	2500	Venezuela	104,9	35,7	54,0	18,3	76,6
Merida	m	smf		Escorial, Mérida	2500	Venezuela	105,2	35,5	60,8	25,3	77,6
Merida	m	mhnp		Mérida	1641	Venezuela	99,9	36,4	56,3	19,9	74,8
Merida	m	amnh	483006	Mérida, Mérida		Venezuela	102,2	35,5	55,2	19,7	78,3
Merida	m	amnh	96322	Mérida, Mérida		Venezuela	105,6	33,6	60,3	26,7	77,2
Merida	m	amnh	146644	Sierra de Mérida, Mérida	3000	Venezuela	100,3	36,7	54,9	18,2	77,5
Nariño	f	amnh	115913	Almaguer, Cauca	3380	Colombia		37,3			73,1
Nariño	f	amnh	115912	Almaguer, Cauca	3380	Colombia	90,9	36,9	46,6	9,7	73,1
Nariño	f	ansp	161990	Cordillera Guamués, Nariño	3400	Colombia	103,8	35,7	51,1	15,4	76,8
Nariño	f	ansp	163083	Tulcán, Carchi	2956	Ecuador	91,0	31,8	58,3	26,5	74,0
Nariño	m	ansp	161987	Cordillera Guamués, Nariño	3400	Colombia	95,5	32,6	63,6	31,0	80,8
Nariño	m	ansp	163082	Tulcán, Carchi	2956	Ecuador	85,1	32,7	62,7	30,0	75,9
Pichincha	f	smf		Gualea		Ecuador	100,8	38,5	51,6	13,1	76,3
Pichincha	f	amnh	124157	Gualea, Pichincha		Ecuador	94,7	38,8	49,8	11,0	78,7
Pichincha	f	amnh	483024	Pichincha		Ecuador	107,3	35,7	55,0	19,3	75,5
Pichincha	f	mhnp		Pichincha Mt.		Ecuador	120,0	35,4	48,9	13,5	78,6
Pichincha	f	zfmk	8749	Tumbaco	2400	Ecuador	110,0	38,4	48,5	10,1	78,4
Pichincha	f	amnh	173211	Yanacocha, Pichincha		Ecuador	110,6	35,6	55,0	19,4	76,5
Pichincha	m	mhnp		Aluguincho		Ecuador	102,9	32,6	52,3	19,7	75,0
Pichincha	m	ansp	163085	Hacienda Turubamba	2900	Ecuador	92,1	35,5	56,6	21,1	77,1
Pichincha	m	mhnp		Lloa	3577	Ecuador	104,2	33,1	62,3	29,2	76,8
Pichincha	m	smf		Lloa	3577	Ecuador	100,2	35,5	59,4	23,9	78,5
Pichincha	m	smf		Lloa	3577	Ecuador	99,4	35,1	61,7	26,6	77,7
Pichincha	m	zfmk	8747	Mindo-Gualea	1550	Ecuador	104,8	35,3	56,9	21,6	75,6

Table 22. List of the revised specimens of *Coeligena* (=*Ensifera*) *ensifera*

POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1-R5	WING-LENGTH
Pichincha	m	ansp	145611	Pichincha	3000	Ecuador	107,6	34,2	65,7	31,5	78,0
Pichincha	m	nmnh	174216	Pichincha		Ecuador	97,3	34,4	60,2	25,8	78,4
Pichincha	m	smf		Pichincha		Ecuador	106,4	40,4	49,4	9,0	75,7
Pichincha	m	zfmk	8733	Santo Domingo	500	Ecuador	110,0	36,1	55,8	19,7	77,5
Pichincha	m	zfmk	8746	Santo Domingo	500	Ecuador	105,0	37,0	53,8	16,8	75,9
Pichincha	m	mhnp		Tambillo	2785	Ecuador	107,5	33,7	62,9	29,2	78,8
Pichincha	m	amnh	483023	W side of Quito		Ecuador	104,3	34,4	59,1	24,7	78,4
Pastaza	f	smf		Baeza		Ecuador	100,2	37,7	52,0	14,3	78,4
Pastaza	f	smf		Baeza		Ecuador	110,3	36,6	53,3	16,7	78,9
Pastaza	f	mhnp		Haut Pastaza, Env. de Baños		Ecuador	114,5	37,8	55,5	17,7	71,7
Pastaza	f	mhnp		Papallacta		Ecuador	103,8	33,7	62,3	28,6	76,0
Pastaza	f	amnh	180063	Papallacta		Ecuador	117,7	37,5	57,4	19,9	78,9
Pastaza	f	zfmk	8745	Papallacta	3000	Ecuador	101,6	36,6	52,2	15,6	76,7
Pastaza	f	amnh	185084	Sumaco Arriba		Ecuador	102,5	39,4	47,7	8,3	74,3
Pastaza	f	amnh	185083	Sumaco Arriba		Ecuador	106,4	36,9	46,8	9,9	69,6
Pastaza	m	smf		Baeza		Ecuador	90,7	33,4	58,8	25,4	77,6
Pastaza	m	smf		Baeza		Ecuador	93,9	35,2	64,4	29,2	81,9
Pastaza	m	smf		Baeza		Ecuador	101,1	33,7	58,7	25,0	79,0
Pastaza	m	smf		Baeza		Ecuador	97,8	35,6	50,9	15,3	74,3
Pastaza	m	nmw	92403	Baños, Río Pastaza (Tungurahua)	1820	Ecuador	107,9	33,8	60,0	26,2	76,4
Pastaza	m	ansp	185235	Cerro Mongus, 3km SE Impueran, Carchi	3300	Ecuador	93,1	34,2	63,7	29,5	75,6
Pastaza	m	ansp	163081	Oyacachi		Ecuador	99,4	33,2	65,7	32,5	79,1
Pastaza	m	amnh	180060	Oyacachi		Ecuador		34,7	65,1	30,4	80,2
Pastaza	m	mhnp		Papallacta		Ecuador	102,2	34,8	64,8	30,0	79,8
Pastaza	m	mhnp		Papallacta		Ecuador	91,9	33,2	60,9	27,7	79,4
Pastaza	m	mhnp		Papallacta		Ecuador	88,3	32,7	58,4	25,7	75,9
Pastaza	m	smf		Papallacta	1400	Ecuador	97,9	38,0	49,1	11,1	74,2
Pastaza	m	zfmk	8731	Papallacta	3000	Ecuador	98,5	40,0	49,0	9,0	74,5
Pastaza	m	ansp	145610	Runtún, near Baños	2000	Ecuador	106,5	36,2	57,5	21,3	78,1
Pastaza	m	ansp	145607	Runtún, near Baños	2000	Ecuador	105,6	37,4	57,9	20,5	77,3
Pastaza	m	ansp	145609	Runtún, near Baños	2200	Ecuador	103,0	33,6	61,2	27,6	82,1
Pastaza	m	ansp	145608	Runtún, near Baños	2000	Ecuador	109,3	32,5	61,8	29,3	79,7
Tarqui-Cajanuma	f	mhnp		El Portete de Cajanuma, Loja	2525	Ecuador	110,6	34,6	61,2	26,6	81,6
Tarqui-Cajanuma	m	mhnp		El Portete de Cajanuma, Loja		Ecuador	102,1	36,1	50,9	14,8	76,1
Tarqui-Cajanuma	m	mhnp		El Portete de Tarquí, Cuenca	2800	Ecuador	111,4	34,9	64,6	29,7	82,1
Huancabamba	f	amnh	235801	Chugur, 40 miles NW of Cajamarca	2745	Peru	103,6	36,3	50,9	14,6	77,3

Table 22. List of the revised specimens of *Coeligena* (=*Ensifera*) *ensifera*

POOLS	SEX	MUSEUM	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL_LENGTH	R1	R5	R1-R5	WING-LENGTH
Huancabamba	f	fmnh	222216	Huancabamba, Tambo, Piura		Peru	99,2	38,3	47,2	8,9	76,1
Huancabamba	f	amnh	235802	Taulís, NE of Pacasmayo	2670	Peru	103,2	37,9	47,1	9,2	76,1
Huancabamba	f	amnh	235806	Taulís, NE of Pacasmayo	2670	Peru	105,3	36,6	53,7	17,1	76,2
Huancabamba	m	zfmk	8736	Cutervo	2649	Peru		36,9	55,0	18,1	78,9
Huancabamba	m	zfmk	8735	Cutervo	2649	Peru	98,3	33,5	61,1	27,6	77,0
Huancabamba	m	zfmk	8737	Cutervo	2649	Peru	97,9	35,5			75,8
Huancabamba	m	zfmk	8738	Cutervo	2649	Peru	98,7	37,9	54,7	16,8	77,1
Huancabamba	m	musm	5966	Hacienda Taulis, Cajamarca	2450	Peru	93,0	33,6	65,5	31,9	80,1
W Marañon	f	amnh	234416	La Lejía, No of Chachapoyas		Peru			48,3		75,0
W Marañon	f	amnh	483026	Leimebamba	3050	Peru	93,2	37,4	53,8	16,4	76,2
W Marañon	m	musm	18511	Los Chochos, ca 25 km NNE Pataz, San Martín	3300	Peru	78,8	32,6	57,9	25,3	75,4
Cuzco	f	musm	5967	Higos, Ajuarcho, Huanta?		Peru		36,3	47,1	10,8	75,7
Cuzco	f	amnh	169593	Maraynioc, Junín	4260	Peru	97,6	37,1	49,1	12,0	75,3
Cuzco	m	musm		2 km NW Pta. Saria on Pozuzo-Chaglla trail,	3100	Peru	80,8	33,7	55,7	22,0	75,1
Cuzco	m	smf		Maraynioc	4260	Peru	92,6	34,6	59,5	24,9	78,0
Cuzco	m	smf		Paucartambo, Cuzco	3000	Peru	84,0	34,4	64,2	29,8	80,7
Cuzco	m	smf		Paucartambo, Cuzco	3000	Peru	91,1	30,6	48,8	18,2	74,0

Table 23. List of the revised specimens of *Coeligena* (=*Pterophanes*) *cyanopterus*

SUBSPECIES	POOLS	SEX	MUSEUM	REF	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL-LENGTH	R1	R5	R1-R5	WING-LENGTH
cyanopterus	Bogota	f	amnh	462	132211	Choachi, Bogotá Region		Colombia	37,3				92,0
cyanopterus	Bogota	m	zfmk	8	8762	Páramos de Bogotá		Colombia	36,4	52,4	63,3	10,9	92,8
caeruleus	Tolima	f	ansp	237	153509	Nevado de Tolima		Colombia	35,8	52,1	66,2	14,1	97,8
caeruleus	Tolima	m	ansp	239	73745	La Leonera, Caldas	3600	Colombia	38,1	52,8	68,6	15,8	100,7
caeruleus	Tolima	m	amnh	481	111609	Santa Isabel, Quindíos		Colombia		53,5	67,2	13,7	98,0
caeruleus	Tolima	m	ansp	238	153508	Nevado de Tolima		Colombia		46,5	58,0	11,5	91,8
caeruleus	Cauca	m	nmnh	13	446343	Puracé, Cauca	2990	Colombia	36,8	51,8	68,7	16,9	100,5
cyanopterus	Cauca	f	fmnh	122	255521	San Rafael, Purocé, Cauca	3375	Colombia	36,8	47,7	69,8	22,1	98,7
cyanopterus	Cauca	m	fmnh	123	255520	San Rafael, Purocé, Cauca	3375	Colombia	38,2	53,3	62,2	8,9	87,9
cyanopterus	Cauca	m	fmnh	124	226508	El Crucero, Cauca	3200	Colombia	36,6		66,6	66,6	
cyanopterus	Cauca	m	fmnh	125	226507	El Crucero, Cauca	3200	Colombia	36,2	47,7	68,7	21,0	104,4
caeruleus	Nariño	m	ansp	236	161978	Páramo Guamués, Nariño		Colombia	36,0	52,3	67,8	15,5	103,1
caeruleus	Nariño	m	ansp	234	149401	Cumbal, Nariño	3032	Colombia	36,7	48,2	64,0	15,8	100,3
caeruleus	Nariño	m	ansp	235	149402	Cumbal, Nariño	3032	Colombia	35,0	50,0	65,2	15,2	101,9
caeruleus	Nariño	m	ansp	233	185219	W slope Cerro Mongus, ca 3 km SE Impueran, Ca	3400	Ecuador	37,9	47,8	70,4	22,6	106,5
cyanopterus	Nariño	m	ansp	232	184600	W slope Cerro Mongus, ca 3 km SE Impueran, Ca	3350	Ecuador	36,5	50,6	61,1	10,5	92,3
peruvianus	Pichincha	f	ansp	257	163073	Pichán, Pichincha	3500	Ecuador	35,7	48,0			102,8
peruvianus	Pichincha	f	amnh	461	483032	Pichincha	3000	Ecuador	36,3	49,7	72,0	22,3	110,4
peruvianus	Pichincha	f	zfmk	11	8761	Bosques del Cráter, Pichincha		Ecuador	35,3	54,4	66,5	12,1	102,6
peruvianus	Pichincha	f	ansp	258	59040	Mt Pichincha		Ecuador	37,7	51,1	54,6	3,5	94,1
peruvianus	Pichincha	f	mhnp	2		Lloa, Pichincha	3577	Ecuador	38,0	48,5	62,0	13,5	97,9
peruvianus	Pichincha	f	ansp	256	148254	San Ignacio, Pichincha	3700	Ecuador	37,3	50,3	69,0	18,7	103,4
peruvianus	Pichincha	f	nmnh	2	173661	Corazón	2750	Ecuador	34,7	47,0	70,1	23,1	107,2
peruvianus	Pichincha	f	nmnh	205	173660	Corazón	2750	Ecuador	37,7	47,5	59,9	12,4	94,6
peruvianus	Pichincha	f	amnh	463	124159	Corazón	2750	Ecuador	35,4	53,6	62,7	9,1	96,9
peruvianus	Pichincha	f	amnh	464	124160	Corazón	2750	Ecuador	37,4	51,1	59,8	8,7	95,5
peruvianus	Pichincha	m	ansp	260	163072	Nonopungo, Pichincha		Ecuador	36,2	49,7	68,4	18,7	105,7
peruvianus	Pichincha	m	amnh	469	483034	Pichincha	3000	Ecuador	37,1	51,9	61,0	9,1	96,8
peruvianus	Pichincha	m	nmnh	8	173666	Pichincha	3000	Ecuador	36,1	46,8	67,1	20,3	103,0
peruvianus	Pichincha	m	nmnh	9	173664	Pichincha	3000	Ecuador	37,6	52,9	69,5	16,6	102,9
peruvianus	Pichincha	m	nmnh	10	173667	Pichincha	3000	Ecuador	35,5	52,0	63,6	11,6	93,5
peruvianus	Pichincha	m	nmnh	11	173669	Pichincha	3000	Ecuador	38,4	52,0	68,0	16,0	102,4
peruvianus	Pichincha	m	nmnh	12	173670	Pichincha	3000	Ecuador	34,5	47,9	70,4	22,5	106,1
peruvianus	Pichincha	m	nmnh	204	173665	Pichincha	3000	Ecuador	35,9	46,7	68,3	21,6	107,0
peruvianus	Pichincha	m	amnh	467	483031	Pichincha	3000	Ecuador	35,1	50,3	65,4	15,1	106,8
peruvianus	Pichincha	m	amnh	468	483033	Pichincha	3000	Ecuador	36,7	48,0	70,3	22,3	110,5
peruvianus	Pichincha	m	ansp	255	59041	Mt Pichincha		Ecuador	36,5	55,7	60,6	4,9	92,1

Table 23. List of the revised specimens of *Coeligena* (=*Pterophanes*) *cyanopterus*

SUBSPECIES	POOLS	SEX	MUSEUM	REF	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL-LENGTH	R1	R5	R1-R5	WING-LENGTH
peruvianus	Pichincha	m	zfmk	6	8758	Bosques del Cráter, Pichincha	600	Ecuador	35,7	49,6	68,5	18,9	106,9
peruvianus	Pichincha	m	ansp	231	59039	Mt Pichincha		Ecuador	34,6	48,3	66,9	18,6	104,7
peruvianus	Pichincha	m	nmnh	3	173662	Corazón	2750	Ecuador	36,4	52,4	62,3	9,9	97,0
peruvianus	Pichincha	m	nmnh	4	173663	Corazón	2750	Ecuador	36,2	44,5	67,1	22,6	106,8
peruvianus	Pichincha	m	nmnh	5	173659	Corazón	2750	Ecuador	35,5	50,1	71,7	21,6	109,9
peruvianus	Papallacta	f	amnh	470	447340	Llanganates	4689	Ecuador	36,1	56,0	61,4	5,4	93,2
peruvianus	Papallacta	m	amnh	482	185081	Sumaco Arriba		Ecuador	35,8	50,8	63,6	12,8	104,7
peruvianus	Papallacta	m	amnh	466	247230	Papallacta		Ecuador	35,4	51,2	68,8	17,6	108,0
peruvianus	Papallacta	m	mhnp	1		Papallacta-Baños		Ecuador	37,4	52,8	67,8	15,0	108,2
peruvianus	Santo Domingo	f	zfmk	4	8757	Camino de Santo Domingo		Ecuador	36,0	53,4	67,7	14,3	106,1
peruvianus	Santo Domingo	m	zfmk	3	8754	Santo Domingo	500	Ecuador	36,4	50,2	60,3	10,1	92,7
peruvianus	Santo Domingo	m	zfmk	1	8751	Santo Domingo	500	Ecuador	35,8	51,1	67,3	16,2	104,9
peruvianus	Santo Domingo	m	zfmk	2	8752	Santo Domingo	500	Ecuador		55,4	66,3	10,9	105,7
peruvianus	Huancabamba	f	smf	1		Cutervo	3200	Peru	36,6	49,9	62,8		96,8
peruvianus	Huancabamba	m	fmnh	120	222189	km 30 road to San Ignacio, Huancabamba	3000	Peru	34,9	52,5	70,2	17,7	105,9
peruvianus	Huancabamba	m	fmnh	119	222188	Huancabamba, Piura	2600	Peru	36,3	54,4	67,5	13,1	106,2
peruvianus	Huancabamba	m	amnh	475	235808	Taulís, NE Pacasmayo	2670	Peru	35,7	53,6			97,7
peruvianus	Libertad	f	ansp	253	115574	Atuén, Amazonas		Peru	37,4	54,0			
peruvianus	Libertad	f	ansp	248	115575	Las Quinuas, Libertad		Peru	37,5	51,3			110,1
peruvianus	Libertad	f	ansp	247	115572	Cajamarquilla, Libertad		Peru	37,0	54,5	74,7	20,2	109,4
peruvianus	Libertad	m	amnh	473	235461	San Pedro, S of Chachapoyas	2290	Peru	35,3	54,7	67,4	12,7	
peruvianus	Libertad	m	ansp	252	115573	Atuén, Amazonas		Peru	37,7	53,7	63,6	9,9	
peruvianus	Libertad	m	ansp	254	115571	Cajamarquilla, Libertad		Peru	35,3	48,1	70,3	22,2	106,1
peruvianus	Huanuco	f	nmnh	6	273097	Macchu Picchu (Cechobamba)	3660	Peru	35,7	52,5	72,5	20,0	106,5
peruvianus	Huanuco	f	nmnh	7	173098	Macchu Picchu (Cechobamba)	3660	Peru	35,7	52,8	72,0	19,2	109,0
peruvianus	Huanuco	f	amnh	477	483030	Marcapata, Quispicanchis		Peru	37,1	49,3	71,7	22,4	112,5
peruvianus	Huanuco	f	ansp	261	103731	Limbani		Peru	39,0	55,9	72,4	16,5	111,5
peruvianus	Huanuco	f	ansp	262	103732	Limbani		Peru	36,1	53,2	69,8	16,6	110,6
peruvianus	Huanuco	m	fmnh	105	299079	Huancapata, Panoa regio, Huánuco	2990	Peru	37,2	49,4	65,4	16,0	101,5
peruvianus	Huanuco	m	fmnh	104	67710	Huánuco Mts	4050	Peru	36,3		72,1		110,6
peruvianus	Huanuco	m	fmnh	106	67709	Huánuco Mts	4050	Peru	36,2	51,6	65,4	13,8	100,5
peruvianus	Huanuco	m	smf	3		Maraynioc		Peru	35,7	50,4	74,9	24,5	114,1
peruvianus	Huanuco	m	amnh	474	820758	29 km NE Tambo; above Puncu, Ayacucho	3500	Peru	38,1	53,7	62,7	9,0	97,4
peruvianus	Huanuco	m	smf	2		Anta, Cuzco	3500	Peru	36,6	54,0	76,2	22,2	101,2
peruvianus	Huanuco	m	fmnh	118	213803	Ccachubamba		Peru		52,0	74,1		114,6
peruvianus	Huanuco	m	zfmk	17	8755	Marcapata	3150	Peru	38,1	47,5	71,1	23,6	114,1
peruvianus	Huanuco	m	fmnh	113	222184	Ccachubamba, Marcapata, Cuzco	2850	Peru	36,5	52,8	64,6	11,8	96,0

Table 23. List of the revised specimens of *Coeligena* (=*Pterophanes*) *cyanopterus*

SUBSPECIES	POOLS	SEX	MUSEUM	REF	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL-LENGTH	R1	R5	R1-R5	WING-LENGTH
peruvianus	Huanuco	m	fmnh	114	222185	Ccachubamba, Marcapata, Cuzco	2850	Peru	37,7	50,6	65,8	15,2	100,1
peruvianus	Huanuco	m	fmnh	115	222183	Ccachubamba, Marcapata, Cuzco	2850	Peru	37,0		70,7		113,8
peruvianus	Huanuco	m	amnh	476	483029	Marcapata, Quispicanchis		Peru	37,4	50,7	74,9	24,2	109,8
peruvianus	Huanuco	m	ansp	249	103726	Limbani		Peru	36,9	52,2	73,3	21,1	110,0
peruvianus	Huanuco	m	ansp	250	103728	Limbani		Peru	37,1	51,2	70,9	19,7	111,2
peruvianus	Huanuco	m	ansp	251	103727	Limbani		Peru	38,2	52,8	60,5	7,7	99,4
peruvianus	Yungas	f	smf	5		Sillunticara		Bolivia	35,5	52,8	68,1	15,3	106,4
peruvianus	Yungas	f	ansp	246	120912	Hichuloma, Yungas de La Paz	3550	Bolivia	36,6	51,4	62,2	10,8	93,8
peruvianus	Yungas	f	amnh	479	37496	Yungas Ranges of Sillunticara	3930	Bolivia	34,3	52,3	68,8	16,5	101,1
peruvianus	Yungas	m	ansp	244	120911	Hichuloma, Yungas de La Paz	3400	Bolivia	38,1		70,2	70,2	110,8
peruvianus	Yungas	m	ansp	245	120910	Hichuloma, Yungas de La Paz	3400	Bolivia	33,1	51,4	72,0	20,6	111,2
peruvianus	Yungas	m	amnh	480	37495	Yungas Ranges of Sillunticara	3930	Bolivia	38,1	52,9	65,7	12,8	94,7
peruvianus	Yungas	m	amnh	478	37494	Yungas Ranges of Sillunticara	3930	Bolivia	36,1	53,7	64,9		97,1
peruvianus	Yungas	m	ansp	240	120913	El Pongo, Yungas	3650	Bolivia		52,8	70,7	17,9	111,9
peruvianus	Cochabamba	f	smf	6		Cocapata	2200	Bolivia		51,6	64,0	12,4	99,3
peruvianus	Cochabamba	f	ansp	241	145228	Incachaca, Cochabamba	2800	Bolivia	35,6	49,8	73,4	23,6	99,6
peruvianus	Cochabamba	f	fmnh	107	179434	Aduana (Incachaca), Cochabamba	3100	Peru	38,0	50,7	62,2	11,5	100,9
peruvianus	Cochabamba	f	zfmk	15	87051	Cochabamba	1667	Bolivia	36,6	50,3	71,7	21,4	109,9
peruvianus	Cochabamba	f	zfmk	16	81659	Cochabamba	1667	Bolivia	37,5	48,6	71,3	22,7	109,3
peruvianus	Cochabamba	m	ansp	242	145230	Incachaca, Cochabamba	2800	Bolivia		51,6	72,6	21,0	114,4
peruvianus	Cochabamba	m	ansp	243	145229	Incachaca, Cochabamba	2800	Bolivia	36,6	50,0	64,6	14,6	99,0
peruvianus	Cochabamba	m	fmnh	108	179429	Aduana (Incachaca), Cochabamba	3100	Peru	37,4	54,8			105,8
peruvianus	Cochabamba	m	fmnh	109	179433	Aduana (Incachaca), Cochabamba	3100	Peru	35,7	52,6	70,8	18,2	109,5
peruvianus	Cochabamba	m	fmnh	110	179430	Aduana (Incachaca), Cochabamba	3100	Peru	36,3	51,4	63,0		96,8
peruvianus	Cochabamba	m	fmnh	111	179431	Aduana (Incachaca), Cochabamba	3100	Peru	39,2	52,8	62,9	10,1	99,3
peruvianus	Cochabamba	m	fmnh	112	179435	Aduana (San Benito), Cochabamba	3100	Peru		50,1			96,3
peruvianus	Cochabamba	m	zfmk	12	84137	Cochabamba	1667	Bolivia	36,6	49,6	69,9	20,3	108,4
peruvianus	Cochabamba	m	zfmk	13	81660	Cochabamba	1667	Bolivia	36,4	49,3	73,5	24,2	112,4
peruvianus	Cochabamba	m	zfmk	14	81658	Cochabamba	1667	Bolivia	36,0	51,1	70,2	19,1	109,8

Table 24. List of the revised specimens of *Patagona gigas*

SUBSPECIES	POOLS	SEX	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL-LENGTH	R1	R5	R1-R5	WING-LENGTH
peruviana	Pichincha	m	124054	Mt. Pichincha		Ecuador	41,7	69,0	81,9	12,9	116,9
peruviana	Pichincha	m	59043	Cumbaja, 6mi. NE of Quito	2450	Ecuador	44,2	65,2	81,5	16,3	125,5
peruviana	Pichincha	m	179999	Valle Tumbaco	2900	Ecuador	41,3	67,8	78,1	10,3	130,3
peruviana	Pichincha	m	4748	Tumbaco	2400	Ecuador	41,5	61,4	76,8	15,4	124,8
peruviana	Pichincha	m	7040	Valle de Rojas		Ecuador	41,7	70,3	74,0	3,7	120,4
peruviana	Pichincha	m	7037	Tumbaco	2400	Ecuador	42,0	64,9	78,2	13,3	126,0
peruviana	Pichincha	m	180000	Valle Tumbaco	2900	Ecuador	42,9	64,1	80,3	16,2	131,4
peruviana	Pichincha	m	179998	Valle Tumbaco	2900	Ecuador	39,8	68,5	78,5	10,0	126,0
peruviana	Pichincha	m	179929	Valle Tumbaco	2900	Ecuador	43,2	66,0	77,4	11,4	117,2
peruviana	Pichincha	m	174381	Valley of Chillo, near Quito		Ecuador	42,4	60,7	78,5	17,8	124,6
peruviana	Pichincha	m	174382	Valley of Chillo, near Quito		Ecuador	41,6		78,4		121,3
peruviana	Pichincha	m	163224	Guaillamba	1900	Ecuador	41,8	66,3	78,8	12,5	116,8
peruviana	Pichincha	m	298746	Guaillabamba	1900	Ecuador	42,5	64,0	74,6	10,6	115,2
peruviana	Pichincha	f	388887	Volcán Pichincha	3300	Ecuador	43,2	63,6	73,4	9,8	120,9
peruviana	Pichincha	f	124044	Mt. Pichincha		Ecuador	39,7	61,9	75,4	13,5	127,3
peruviana	Pichincha	f	59044	Cumbaja, 6mi. NE of Quito	2450	Ecuador	41,0	66,0	77,9	11,9	128,7
peruviana	Pichincha	f	7047	Tumbaco	2400	Ecuador	42,7	62,1	72,2	10,1	130,4
peruviana	Pichincha	f	7039	Valle de Rojas		Ecuador	40,4	69,0	71,8	2,8	119,3
peruviana	Pichincha	f	175130	Valle Tumbaco	2900	Ecuador	41,8	63,9	71,5	7,6	121,7
peruviana	Pichincha	f	180001	Valle Tumbaco	2900	Ecuador	41,9	65,7	77,8	12,1	127,8
peruviana	Pichincha	f	7038	Valle de Rojas		Ecuador	41,4	63,1	70,0	6,9	112,9
peruviana	Pichincha	f	174383	Valley of Chillo, near Quito		Ecuador	41,9	63,8	79,2	15,4	124,3
peruviana	Pichincha	f	174380	Valley of Chillo, near Quito		Ecuador	40,7	67,6	74,3	6,7	120,6
peruviana	Pichincha	f	163226	Guaillamba	1900	Ecuador	44,3	64,0	79,7	15,7	127,0
peruviana	Pichincha	f	298749	Guaillabamba	1900	Ecuador	43,2	63,4	74,9	11,5	114,1
peruviana	Pichincha	f		Quebrada Miraflores, Pichincha		Ecuador	40,5	66,6	80,7	14,1	128,7
peruviana	Pichincha	f	7041	Camino a Santo Domingo		Ecuador	40,5	66,9	76,2	9,3	122,1
peruviana	Cutervo	m	80114	Huancabamba	1929	Peru	42,1	60,9	79,3	18,4	120,4
peruviana	Cutervo	m	7036	Cutervo	2649	Peru	41,0	64,6	77,8	13,2	134,1
peruviana	Cutervo	m	87052	Cochabamba	1667	Bolivia	41,0		74,3		119,8
peruviana	Cutervo	f	175131	Huancabamba, Piura	1895	Peru	45,0	65,0	80,1	15,1	123,4
peruviana	Cutervo	f	175130	Huancabamba, Piura	1895	Peru	43,5	67,9	80,5	12,6	
peruviana	Cutervo	f	175132	Huancabamba, Piura	1895	Peru	43,7	64,1	75,8	11,7	106,6
peruviana	Cutervo	f	175128	Huancabamba, Piura	1895	Peru	40,1	61,6	84,6	23,0	127,1
peruviana	Cutervo	f	175129	Huancabamba, Piura	1895	Peru	45,5	59,5	78,5	19,0	120,2
peruviana	Cajamarca	m	479601	Cajamarca	3000	Peru	42,9	71,2	79,1	7,9	125,9
peruviana	Cajamarca	m	45800	Cajamarca	3050	Peru	44,8	65,8	84,5	18,7	132,7
peruviana	Cajamarca	m	479600	Cajabamba	2900	Peru		69,2	88,9	19,7	136,6
peruviana	Cajamarca	m	45799	Hacienda La Llagueda, NE of Otusco	1980	Peru		63,5	81,2	17,7	131,4
peruviana	Cajamarca	m	479604	Huamachuco	3300	Peru	45,9	68,8	83,1	14,3	128,4
peruviana	Cajamarca	m	479605	Huamachuco	3300	Peru	42,9	67,8			129,3
peruviana	Cajamarca	f		Cajamarca	2990	Peru	43,7	68,5	84,5	16,0	124,2
peruviana	Cajamarca	f		Cajamarca	3150	Peru	49,6	69,2	81,6	12,4	125,1

Table 24. List of the revised specimens of *Patagona gigas*

SUBSPECIES	POOLS	SEX	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL-LENGTH	R1	R5	R1-R5	WING-LENGTH
peruviana	Cajamarca	f		Cajamarca	2990	Peru	44,7	71,9	83,7	11,8	126,4
peruviana	Cajamarca	f		Cajabamba	2990	Bolivia	45,9	69,3	85,3	16,0	135,1
peruviana	Cajamarca	f		Huamachuco, La Libertad	3650	Peru	44,6	65,0	77,1	12,1	125,4
peruviana	Cajamarca	f	479603	Huamachuco	3300	Peru	46,5	63,3	81,0	17,7	134,3
peruviana	Cajamarca	f	479602	Succha, Huamachuco	3000	Peru	45,5	67,5	79,6	12,1	126,8
peruviana	Ancash	m	47029	Macate	3200	Peru	44,8	69,3	86,5	17,2	134,4
peruviana	Ancash	m	47034	Macate	3200	Peru	46,0	68,9	84,1	15,2	135,1
peruviana	Ancash	m	47036	Macate	3200	Peru	45,8	64,7	83,1	18,4	134,7
peruviana	Ancash	m	47039	Macate	3200	Peru	45,8	70,6	84,9	14,3	133,3
peruviana	Ancash	m	47030	Macate	3200	Peru	46,9	64,9	82,1	17,2	137,0
peruviana	Ancash	m	47038	Macate	3200	Peru	43,6	64,0	78,6	14,6	131,1
peruviana	Ancash	m	47024	Macate	3200	Peru	43,3	72,3	87,0	14,7	127,3
peruviana	Ancash	m	47026	Macate	3200	Peru	45,3	60,9	80,2	19,3	130,4
peruviana	Ancash	m	222179	Yugay, Ancash	2335	Peru	44,8	69,5	87,8	18,3	133,6
peruviana	Ancash	m	222178	Yugay, Ancash	2335	Peru	42,5	64,0	79,1	15,1	132,5
peruviana	Huanuco	m	67520	Cullcui, Marañón River	3170	Peru	45,2	67,1	81,3	14,2	127,5
peruviana	Huanuco	m	278328	La Unión, Huánuco	3204	Peru	43,8	71,2	87,7	16,5	133,6
peruviana	Junin	m	173981	Chipa, Junin	3890	Peru	45,7	67,0	79,4	12,4	136,7
peruviana	Junin	m	168949	Acobamba, Junin	3000	Peru	43,2	64,3	81,0	16,7	126,2
peruviana	Junin	m	168951	Acobamba, Junin	3000	Peru	44,1	62,0	76,8	14,8	133,8
peruviana	Junin	m	165629	Oroya, Rio Mantaro		Peru		70,3	82,2	11,9	127,4
peruviana	Junin	m	165632	Oroya, Rio Mantaro		Peru	45,4	67,0	77,8	10,8	123,7
peruviana	Junin	f	173984	Chipa, Junin	3890	Peru	44,4	72,3	85,9	13,6	133,4
peruviana	Junin	f	173983	Chipa, Junin	3890	Peru	45,5	69,9	80,0	10,1	126,2
peruviana	Junin	f	168952	Acobamba, Junin	3000	Peru	44,8	65,9	80,9	15,0	134,5
peruviana	Junin	f	168950	Acobamba, Junin	3000	Peru	44,1	70,8	79,7	8,9	122,7
peruviana	Junin	f	7055	Tarma	4270	Peru	44,9	68,0	79,7	11,7	125,5
peruviana	Junin	f	92667	Tarma, Junín	3600	Peru		68,2	81,4	13,2	125,7
peruviana	Junin	f	92668	Tarma, Junín	3600	Peru	44,0	65,6	81,4	15,8	121,1
peruviana	Junin	f	92669	Tarma, Junín	3600	Peru	43,0	68,4	78,6	10,2	125,6
peruviana	Junin	f	165631	Oroya, Rio Mantaro		Peru	43,7	70,9			133,5
peruviana	Junin	f	165630	Oroya, Rio Mantaro		Peru	43,3	67,9	77,1	9,2	127,4
peruviana	Junin	f	67517	Matucana		Peru	42,3	61,1	81,9	20,8	131,2
peruviana	Junin	f	67518	Matucana		Peru	38,2		81,7		118,5
peruviana	Cuzco	m	145019	Huaracondo Cañón	3050	Peru	41,2	65,0	82,6	17,6	127,5
peruviana	Cuzco	m	273086	Ollantaytambo	2846	Peru	41,8	69,1	77,6	8,5	121,4
peruviana	Cuzco	m	145016	Ollantaytambo	2846	Peru	41,9	68,2	77,3	9,1	120,7
peruviana	Cuzco	m	54935	Paucartambo	2906	Peru	43,7	70,7	74,8	4,1	134,3
peruviana	Cuzco	m	273518	Pisac	2972	Peru	40,5	67,3	81,7	14,4	126,4
peruviana	Cuzco	m		Anta, Cuzco	3000	Peru	43,8	65,9	80,9		129,7
peruviana	Cuzco	m	129139	Cuzco	3400	Peru	42,5	63,4	81,9	18,5	134,1
peruviana	Cuzco	m	222181	Hacienda La Laguna, Andahueylos, Apurímac	3040	Peru	43,4	67,7	78,8	11,1	125,6
peruviana	Cuzco	m	150091	Marangani, Cuzco valley	4300	Peru		62,8	81,0	18,2	131,9

Table 24. List of the revised specimens of *Patagona gigas*

SUBSPECIES	POOLS	SEX	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL-LENGTH	R1	R5	R1-R5	WING-LENGTH
peruviana	Cuzco	m		Vilcanota, Cuzco	3000	Peru	42,1	59,9	79,0	19,1	124,3
peruviana	Cuzco	m	273522	La Raya	4314	Peru	40,9	66,1	71,8	5,7	121,1
peruviana	Cuzco	m	273521	Pisac	2972	Peru	40,8	66,5	80,2	13,7	136,8
peruviana	Cuzco	m	273519	Pisac	2972	Peru	41,0	66,4	76,3	9,9	126,8
peruviana	Cuzco	f	273484	Chospiyoc	3050	Peru		64,1	84,8	20,7	133,8
peruviana	Cuzco	f	273088	Chospiyoc	3050	Peru	41,8	63,5	73,5	10,0	128,2
peruviana	Cuzco	f	273087	Chospiyoc	3050	Peru	41,1	72,0	79,7	7,7	124,5
peruviana	Cuzco	f	145017	Ollantaytambo	2846	Peru	43,3	65,6	81,6	16,0	134,4
peruviana	Cuzco	f	145018	Ollantaytambo	2846	Peru	43,2	65,9	80,0	14,1	135,7
peruviana	Cuzco	f	145015	Ollantaytambo	2846	Peru		69,5	79,8	10,3	121,1
peruviana	Cuzco	f	145020	Huaracondo Cañón	3050	Peru	40,9	68,9	83,3	14,4	128,4
peruviana	Cuzco	f	273520	Pisac	2972	Peru	43,1		79,7		130,8
peruviana	Cuzco	f	273517	Pisac	2972	Peru	42,4	66,8	78,6	11,8	123,9
peruviana	Cuzco	f	145014	Tica-Tica, near Cuzco	3510	Peru	42,4	66,7	80,9	14,2	121,3
peruviana	Cuzco	f	145013	Tica-Tica, near Cuzco	3510	Peru	41,9	69,7	81,0	11,3	125,2
peruviana	Cuzco	f	129144	Cuzco	3400	Peru	43,5	66,6	82,0	15,4	136,5
peruviana	Cuzco	f	129141	Cuzco	3400	Peru	41,7	68,4	80,3	11,9	117,5
peruviana	Cuzco	f	129142	Cuzco	3400	Peru	41,7	61,2	78,2	17,0	119,8
peruviana	Cuzco	f	129143	Cuzco	3400	Peru	42,1	70,2	84,4	14,2	136,0
peruviana	Cuzco	f	222182	Hacienda La Laguna, Andahueylos, Apurímac	3040	Peru	42,8		80,9		133,8
peruviana	Cuzco	f		Labramarca, Cuzco	4000	Peru	41,1	66,0	79,2		123,5
peruviana	Cuzco	f	153152	Hacienda Victoria, Quebrada Matara, Apurímac	2135	Peru	44,9	64,9	81,4	16,5	
peruviana	Cuzco	f	2437	Tinta	3466	Peru	45,7	72,5	84,3	11,8	125,7
peruviana	Cuzco	f	166518	La Raya	4314	Peru	41,7	63,7	82,8	19,1	137,6
peruviana	Arequipa	m	54970	Queñuani. Azúngaro, Puna		Peru	38,2	59,9	69,7	9,8	125,7
peruviana	Arequipa	m	229092	Arequipa	2335	Peru	46,7	63,0	77,4	14,4	129,9
peruviana	Arequipa	m	118728	Puno		Peru	46,0	66,3	80,8	14,5	125,9
peruviana	La Paz	m	7044	La Paz	3630	Bolivia	42,3	64,5	85,4		129,2
peruviana	La Paz	m	172374	La Paz	3630	Bolivia	45,3	61,1	82,2		122,8
peruviana	La Paz	m		La Paz		Bolivia	43,5	61,3	85,6	24,3	137,7
peruviana	La Paz	m	120934	Calacoto, La Paz	3600	Bolivia	44,5	62,5	81,4	18,9	130,5
peruviana	La Paz	m	120836	Calacoto, La Paz	3600	Bolivia	43,4	64,8	80,5	15,7	126,7
peruviana	La Paz	f	120835	Calacoto, La Paz	3600	Bolivia	43,6	62,3	90,6	28,3	138,5
peruviana	La Paz	f		La Paz		Bolivia	44,0	62,0	78,2	16,2	133,9
peruviana	La Paz	f		La Paz		Bolivia	44,9	64,1	83,6	19,5	129,9
peruviana	La Paz	f	803397	25 km SE of La Paz		Bolivia	44,3	63,7	87,3		136,5
peruviana	La Paz	f		La Paz		Bolivia	43,3	59,8	84,0		141,0
peruviana	Cochabamba	m	179407	Cochabamba, Cochabamba	2550	Bolivia	44,6	63,1	84,4	21,3	136,8
peruviana	Cochabamba	m	7050	Tireque, Cochabamba	3500	Bolivia		66,2	70,3	4,1	127,6
peruviana	Cochabamba	m	57260	Vila Vila	2300	Bolivia	41,3	68,4	81,3	12,9	124,8
peruviana	Cochabamba	m	179408	Tiraque, Cochabamba	3500	Bolivia	44,4	65,6	81,2	15,6	129,3
peruviana	Cochabamba	m	179394	Vacas, Cochabamba	3000	Bolivia	37,8	57,1	78,9	21,8	128,1
peruviana	Cochabamba	m	179396	Vacas, Cochabamba	3000	Bolivia	41,3	61,3	70,7	9,4	116,5

Table 24. List of the revised specimens of *Patagona gigas*

SUBSPECIES	POOLS	SEX	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL-LENGTH	R1	R5	R1-R5	WING-LENGTH
peruviana	Cochabamba	m	179401	Arani, Cochabamba	2752	Bolivia	42,8	59,9			125,7
peruviana	Cochabamba	m	179398	Arani, Cochabamba	2752	Bolivia	45,3	67,9	85,9	18,0	137,3
peruviana	Cochabamba	m	179397	Arani, Cochabamba	2752	Bolivia	44,8	65,8	80,3	14,5	124,9
peruviana	Cochabamba	m	7053	Arani, Cochabamba	2900	Bolivia	44,0	63,2			132,8
peruviana	Cochabamba	m	139180	Totora, Cochabamba	2600	Bolivia	43,1	65,0	80,3	15,3	132,6
peruviana	Cochabamba	m	148279	Arque, Cochabamba	2700	Bolivia	44,3	63,0	85,2	22,2	137,0
peruviana	Cochabamba	f	7049	Arani, Cochabamba	2900	Bolivia		65,7	80,5	14,8	137,2
peruviana	Cochabamba	f	179405	Colomi, Cochabamba	3075	Bolivia	41,7	64,5	75,1	10,6	121,1
peruviana	Cochabamba	f	179402	Colomi, Cochabamba	3075	Bolivia	42,7	62,7			127,4
peruviana	Cochabamba	f	179404	Colomi, Cochabamba	3075	Bolivia	43,5	65,6			123,8
peruviana	Cochabamba	f	179406	Cochabamba, Cochabamba	2550	Bolivia	44,6	62,2	83,5	21,3	127,3
peruviana	Cochabamba	f	7054	Tireque, Cochabamba	3400	Bolivia	43,4	63,8	81,9	18,1	133,7
peruviana	Cochabamba	f	7057	Tireque, Cochabamba	3500	Bolivia	44,8	64,3	84,3	20,0	134,3
peruviana	Cochabamba	f	7052	Arani, Cochabamba	2800	Bolivia		66,2			135,6
peruviana	Cochabamba	f	179399	Arani, Cochabamba	2752	Bolivia	39,6	65,0	76,6	11,6	127,1
peruviana	Cochabamba	f	179400	Arani, Cochabamba	2752	Bolivia	44,0	67,5	87,4	19,9	139,5
peruviana	Cochabamba	f	52245	Poopó, Sud	3700	Bolivia	47,4	63,4	77,6		124,4
gigas	Tacna	m	529148	El Misti,near Arequipa	4600	Peru	40,6	59,0	79,5	20,5	
gigas	Tacna	m	529149	El Misti,near Arequipa	2990	Peru	42,0	58,6	79,4	20,8	125,5
gigas	Tacna	m	61681	Putre, Tacna	3550	Chile	47,2	65,9	84,9	19,0	133,3
gigas	Tacna	m	61582	Putre, Tacna	3550	Chile	47,4	70,0	81,4	11,4	127,0
gigas	Tacna	f		Palca, Tacna	3000	Peru	44,6	65,6	86,5	20,9	130,9
gigas	Tacna	f	61680	Putre, Tacna	3550	Chile	43,8	60,0	82,9	22,9	136,7
gigas	Tacna	f	287252	Chusmisa, Tarapacá	3170	Chile	45,9	64,8	79,7	14,9	121,2
gigas	Tarija	m	293681	27 km SE Camargo, 18 km W Culpina, Chuquisaea	2900	Bolivia	44,5		79,0		124,2
gigas	Tarija	m	139179	Río Pilcomayo, Sucre		Bolivia	47,0	53,6	91,3	37,7	134,9
gigas	Tarija	m	145421	Finca Salo (Oploca), Potosí	3600	Bolivia	45,5	63,9	83,8	19,9	131,2
gigas	Tarija	m	293683	Tojo, 128 km SW Tarija	2600	Bolivia	39,5	59,5	73,3	13,8	114,9
gigas	Tarija	m	57059	Colalao del Valle, Tucumán	2500	Argentina	44,4	62,4	81,1	18,7	120,0
gigas	Tarija	f	293680	27 km SE Camargo, 18 km W Culpina, Chuquisaea	2900	Bolivia	44,0	63,4	79,0	15,6	123,2
gigas	Tarija	f	145418	Finca Salo (Oploca), Potosí	3600	Bolivia	44,8		80,9		128,1
gigas	Tarija	f	145417	Finca Salo (Oploca), Potosí	3600	Bolivia	38,3	55,9	74,0	18,1	114,0
gigas	Tarija	f	145419	Finca Salo (Oploca), Potosí	3600	Bolivia	45,5	60,5	78,0	17,5	126,8
gigas	Salta	m	140720	Tilcara	2461	Argentina	40,2	57,0	76,0	19,0	118,1
gigas	Salta	m	140719	Tilcara	2461	Argentina	45,0	60,3	83,8	23,5	125,7
gigas	Salta	m	140718	Tilcara	2461	Argentina	42,8	64,9	81,2	16,3	132,6
gigas	Salta	m	479595	Tílcara, Jujuy	2470	Argentina	41,7	61,1	74,0	12,9	123,1
gigas	Salta	m	479593	Lara, Tucumán	4000	Argentina	45,4	62,2	79,5	17,3	134,0
gigas	Salta	m	479596	Fuerte de Andalgala, Catamarca	1060	Argentina ?	40,7	61,5	74,7	13,2	118,0
gigas	Salta	f	66745	Cordillera Salta	3500	Argentina	44,5	63,1	80,3	17,2	121,7
gigas	Salta	f	262196	Luracatao, Salta	3500	Argentina	47,0	61,9	82,2	20,3	138,8
gigas	Salta	f	479594	Lara, Tucumán	4000	Argentina	42,7	65,5	80,3	14,8	133,5
gigas	Atacama-Santiago	m	61678	Caldera, Atacama	0	Chile	39,2	56,6	77,1	20,5	125,3

Table 24. List of the revised specimens of *Patagona gigas*

SUBSPECIES	POOLS	SEX	NO_CAT	LOCALITY	ALTITUDE	COUNTRY	BILL-LENGTH	R1	R5	R1-R5	WING-LENGTH
gigas	Atacama-Santiago	m	61676	Caldera, Atacama	0	Chile		55,6	72,9	17,3	120,1
gigas	Atacama-Santiago	m	61674	Caldera, Atacama	0	Chile	39,1	57,5	76,5	19,0	120,3
gigas	Atacama-Santiago	m	147334	Tofo		Chile	38,9	58,5	75,4	16,9	126,1
gigas	Atacama-Santiago	m	147348	Tofo		Chile	38,7	60,8	79,2	18,4	121,8
gigas	Atacama-Santiago	m	147338	Tofo		Chile		59,5	80,6	21,1	130,8
gigas	Atacama-Santiago	m	147337	Tofo		Chile	39,8	54,3	79,9	25,6	124,2
gigas	Atacama-Santiago	m	61669	La Compañía Coquimbo	0	Chile	39,0	57,4	75,1	17,7	130,4
gigas	Atacama-Santiago	m	287247	Zapallar, Aconcagua	0	Chile	38,9	58,5	75,5	17,0	119,6
gigas	Atacama-Santiago	m	541361	La Cruz (Quillota)	100	Chile	39,7	59,6	79,8	20,2	131,1
gigas	Atacama-Santiago	m		La Cruz. Fdo. Sta. Ana, Valparaíso		Chile		56,9	81,9		133,3
gigas	Atacama-Santiago	m	7033	Quillota	128	Chile	37,2	53,6	71,3	17,7	124,9
gigas	Atacama-Santiago	m	165634	Valparaíso	0	Chile	38,8	57,4	76,1	18,7	119,9
gigas	Atacama-Santiago	m	23401	Valparaíso	0	Chile	39,8	56,5	78,8	22,3	125,5
gigas	Atacama-Santiago	m	541362	Viña del Mar	0	Chile	39,7	56,9	73,8	16,9	124,1
gigas	Atacama-Santiago	m	287248	Las Cenizas, Valparaíso	0	Chile	39,1	59,4	77,9	18,5	119,2
gigas	Atacama-Santiago	m	316664	Lampa, Santiago	450	Chile	38,7	60,5			
gigas	Atacama-Santiago	m	145835	Apoquindo, Santiago	1000	Chile	41,2	58,7	76,1	17,4	132,4
gigas	Atacama-Santiago	m	61670	San José de Maipo, Santiago	1000	Chile	38,7	55,8	77,6	21,8	125,7
gigas	Atacama-Santiago	f	287249	Las Bombas, Chañarol		Chile	39,0	59,1	72,7	13,6	113,2
gigas	Atacama-Santiago	f	61675	Caldera, Atacama	0	Chile	39,4	57,4	82,0	24,6	123,7
gigas	Atacama-Santiago	f	287250	El Sauce, Freisina	300	Chile	40,4	58,6	74,2	15,6	120,3
gigas	Atacama-Santiago	f	147341	Tofo		Chile		56,3	76,2	19,9	119,6
gigas	Atacama-Santiago	f	147335	Tofo		Chile	39,1	60,1	74,9	14,8	115,5
gigas	Atacama-Santiago	f		El Molle, Valle del Elqui		Chile	40,4	59,2	75,9		126,9
gigas	Atacama-Santiago	f	61671	Papudo, Aconcagua	20	Chile	39,9	59,5	79,9	20,4	125,6
gigas	Atacama-Santiago	f	61672	Los Maiteines, Limache (Papudo)	150	Chile	38,7	52,8	69,7	16,9	117,7
gigas	Atacama-Santiago	f		Olmué (Limache), Valparaíso		Chile					
gigas	Atacama-Santiago	f	541360	El Salto, Viña del Mar	0	Chile	41,2	55,9	73,4	17,5	120,9
gigas	Atacama-Santiago	f	287246	Llolleo	0	Chile	41,9	56,8	80,5	23,7	128,6
gigas	Mendoza	f	147948	Mendoza	964	Argentina	39,2	60,1	76,9	16,8	124,2
gigas	Mendoza	f	147947	Mendoza	964	Argentina	40,8	61,9	73,3	11,4	116,0
gigas	Mendoza	f	147949	Mendoza	964	Argentina	41,0	56,1	73,3	17,2	112,0

Gazetteer with the localities found in the visited collections and their geographic coordinates
In the latitude the north or south position is indicated. All longitude values are located in the
Western Hemisphere. Altitude in meters above see level.

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
12 km E trail La Peca, Amazonas	2000	Peru	0535S	7822
14 km E. of Luisiana, Cordillera Vilcabamba	2050	Ecuador	1238S	7328
15 km E (road) E Canchaque on Huancabamba.	1830	Peru	0524S	7935
18 km E of Limbura, Loja	3100	Ecuador	0440S	7925
2 km NW Pta. Saria on Pozuzo-Chaglla trail,	3100	Peru	0943S	7554
20km N Pichincha, Cord. Alaspungo		Ecuador	0000	7836
25 km SE of La Paz		Bolivia	1630S	6809
27 km SE Camargo, 18 km W Culpina, Chuquisaea	2900	Bolivia	2050S	6458
29 km NE Tambo; above Puncu, Ayacucho	3500	Peru	1247S	7349
3 km E of Carpish Tunnel, Huánuco	2600	Peru	0940S	7605
35 km S Cabudare, Lara	1400	Venezuela	0955N	6918
44 km ESE Cerro Mayordomo, Bosque Huamba, Piura	2950	Peru	0441S	7930
7 km N, 3 km E Chota, Cajamarca	2800	Peru	0632S	7838
7 km road NW Carpish Pass, Huánuco	2450	Peru	0937S	7605
7 km road to NW Carpish Pass, Huánuco	2560	Peru	0940S	7605
9 km E of Limbura, Loja	2700	Ecuador	0440S	7926
9 km E of Luisiana, Cordillera Vilcabamba, Ayacucho	1450	Peru	1239S	7330
A				
Above Chinapinza, Cordillera del Cóndor, Zamora-Chinchipe	1700	Ecuador	0358S	7829
Above Chinapinza, Zamora-Chinchipe	1950	Ecuador	0357S	7831
Above Machu Picchu, Cuzco	2600	Peru	1307S	7234
Abra de Maruncunca, 10 km SW San Juan del Oro, Puno	2000	Peru	1414S	6917
Acobamba, Junin	3000	Peru	1120S	7541
Aduana (Incachaca), Cochabamba	3100	Peru	1714S	6549
Aduana (San Benito), Cochabamba	3100	Peru	1714S	6549
Aguabonita, Mun de Silvania, Cundinamarca	2300	Colombia	0430N	7420
Almaguer, Cauca	3380	Colombia	0156N	7646
Alto de las Cruces, West Cordiller.	2200	Colombia	0647N	7548
Alto del Pozo, Santander N	2950	Colombia	0806N	7303
Alto Pastaza, Env. de Baños		Ecuador	0124S	7825
Aluguincho		Ecuador	0003N	7823
Ambato		Ecuador	0115S	7830
Ambato, Tungurahua	2600	Ecuador	0115S	7837
Andalucía western slope, Huila	900	Colombia	0154N	7540
Angostura, Santander Norte	2500	Colombia	0723N	7254
Anolaima, Cundinamarca	1500	Colombia	0446N	7428
Anta, Cuzco	3000	Peru	1329S	7209
Antioquia	700	Colombia	0633N	7550
Antioquia, Antioquia		Colombia	0612N	7530
Apoquindo, Santiago	1000	Chile	3324S	7032
Arani, Cochabamba	2800	Bolivia	1734S	6546
Arequipa	2335	Peru	1508S	7007
Arque, Cochabamba	2700	Bolivia	1748S	6623
Atuén, Amazonas		Peru	0645S	7752
Azuay, Pacific slope ca. 5 km W Molleturo	3250	Ecuador	0248S	7926

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
B				
Baeza	1525	Ecuador	0027S	7753
Baeza Arriba, Napo	1375	Ecuador	0027S	7753
Baeza, Orient Ecuador	1525	Ecuador	0027S	7753
Bagua Grande, Bosque Undina, Amazonas	1700	Peru	0538S	7823
Baños, Río Pastaza, Tungurahua	1820	Ecuador	0118S	7805
Baños, Tungurahua	2000	Ecuador	0214S	7825
Baños, Tungurahua	2200	Ecuador	0120S	7825
Belén, 45km SW of La Plata, Huila	2300	Colombia	0215N	7605
Bellow Papallacta	3149	Ecuador	0022S	7808
Between Loja and Zamora	3280	Ecuador	0402S	7909
between St. Lucas and Loja	2490	Ecuador	0344S	7913
Boca de Monte, Pregonero, Táchira	2400	Venezuela	0801N	7146
Bogotá	2590	Colombia	0436N	7405
Bosque de Cachil, Cajamarca, Rio Chicama	2470	Peru	0623S	7917
Bosque de Chiñama, Loma Larga, Lambayeque	2250	Peru	0606S	7927
Bosque de Huamba, Ayabaca, Piura	2850	Peru	0441S	7930
Bosque Millpo, Molinopampa, Amazonas	2620	Peru	0608S	7729
Bosques del Cráter, Pichincha		Ecuador	0010S	7833
Bucaral, Yaracuy	1300	Venezuela	1021N	6857
Bucaramanga, Santander	1008	Colombia	0708N	7309
Bucaramanga, Santander	1008	Colombia	0709N	7306
Buena Vista, Huila	2300	Colombia	0152N	7556
Buenavista (Virolín), La Argentina		Colombia	0605N	7312
Buenos Aires, Santander N, Highway Ábrego (?)-Sardinata	1980	Colombia	0805N	7301
Buenos Aires, Santander No	1900	Colombia	0801N	7258
C				
ca 3 km SE Impueran, W slope Cerro Mongus, Carchi	3300	Ecuador	0027N	7752
ca 7 km SE Saraguro, Cord Cordoncillo, Loja	3175	Ecuador	0341S	7913
ca. 20 km by road W. Leimabamba, Amazonas	3100	Peru	0642S	7752
ca. 28 km NE de Pataz, La Playa, San Martín	2640	Peru	0744S	7737
ca. 32 km Pataz, Las Palmas, San Martín	2195		0744S	7737
ca. 8 km NW Cushi on trail to Chaglla, Playa Pampa, Pasco	2100	Peru	0951S	7550
ca. 9 km SSE Oxapampa, Sta. Cruz, Pasco	2050	Peru	1033S	7517
Cabecera Río San Alberto, Pque Nacional Yanachapa-Chemillén, Oxapampa	2600	Peru	1017S	7529
Cajabamba	2990	Bolivia	0710S	7831
Cajabamba, Cajamarca	2745	Peru	0737S	7803
Cajamarca	2990	Peru	0708S	7829
Cajamarca, Cajamarca	2745	Peru	0710S	7831
Cajamarquilla, Libertad		Peru	0718S	7748
Cajanuma Divide, Loja	2450	Ecuador	0405S	7912
Calacalí		Ecuador	0001N	7831
Calacoto, La Paz	3600	Bolivia	1632S	6806
Caldera, Atacama	0	Chile	2704S	7050
Cali, n. Buenaventura	2100	Colombia	0331N	7638
Camino a Pailón		Ecuador	0029N	7755
Camino a Santo Domingo		Ecuador	0115S	7909
Camino de Ayabaca, Prov. Ayabaca, Piura	2950	Peru	0441S	7930
Camino Lambate, S. Yungas	2400	Bolivia	1637S	6736

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
Camp above Hiroca (S of South Teta) Sierra de Perijá	1800	Colombia	0942N	7305
Camp. Las Carpas, Bosque de Montero, Santa Cruz, Ca	1950	Peru	0636S	7857
Camp. No.1 below Limbani, Puno		Peru	1408S	6942
Campamento Frontera 2, Sierra Perijá, Zulia	3000	Venezuela	0959N	7258
Campang, above Utcubamba on trail to Ongón, La Libertad	2625	Peru	0812S	7708
Campang, above Utcubamba, on trail to Ongón, La Libertad	2250	Peru	0813S	7705
Caracas, Dto. Federal	917	Venezuela	1030N	6655
Ccachubamba, Marcapata, Cuzco	2850	Peru	1330S	7055
Cebolleta, Cuchilla	2350	Colombia	1055N	7355
Cebolleta, Cuchilla	2350	Colombia	1057N	7354
Cecche	3275	Ecuador	0211S	7849
Ceja de Juno, Cochabamba	3000	Bolivia	1717S	6547
Cendé, Páramo Cendé, Trujillo	2700	Venezuela	0928N	7005
Cerca de Cascabamba, cerca Llama	2400	Peru	0631S	7907
Cerro Avispa, Fila Macoíta y Apón, Perijá, Zulia	2175	Venezuela	0957N	7258
Cerro Caracas, Santa Marta		Colombia	1057N	7334
Cerro de Pantiacolla, above Río Palotoa	1075	Peru	1230S	7131
Cerro El Candelo, Aroa, Yaracuy	1500	Venezuela	1014N	6900
Cerro El Cobre, Páramo Tamá, Táchira	2800	Venezuela	0725N	7220
Cerro Golfo Triste, San Casimiro, Aragua	1000	Venezuela	1001N	6656
Cerro Mongus, 3km SE Impueran, Carchi	3300	Ecuador	0029S	7749
Cerro Munchique, W. of Popayán, Cauca	2730	Colombia	0232N	7657
Cerro Munchiquito, Cauca	2460	Colombia	0232N	7657
Cerro Palma		Ecuador	0019S	7855
Cerro Pantiacolla, above Río Palotoa, Madre de Dios	1350	Peru	1230S	7131
Cerro Papelón, Cerro Ávila	1900	Venezuela	1032N	6652
Cerro Pejochaina, cumbre, Perijá, Zulia	2300	Venezuela	0957N	7258
Cerro Tetari, Perija, Zulia	2900	Venezuela	1002N	7302
Cerros del Sira (at summit) , Huánuco	2220	Peru	0925S	7442
Chachapoyas, Amazonas	2335	Peru	0611S	7758
Chaco, Yungas		Bolivia	1620S	6748
Charalá, Cañaverales		Colombia	0605N	7312
Chaupe, Cajamarca	2000	Peru	0511S	7910
Chaupe,Cajamarca	1860	Peru	0510S	7910
Chenducua, Río Guatapurí, Sierra de Santa Marta	1800	Colombia	1047N	7325
Chical, Cañar	3075	Ecuador	0224S	7858
Chilpes, Junín	2225	Peru	1119S	7516
Chilpes, Junín	2225	Peru	1121S	7514
Chipa, Junin	3890	Peru	1042S	7557
Chipaque		Colombia	0427N	7403
Chira, Cajamarca	2460	Peru	0616S	7842
Choachi, Bogotá Region		Colombia	0433N	7358
Choachi, Cundinamarca	1966	Colombia	0432N	7356
Chospiyoc	3050	Peru	1316S	7221
Chugur, 40 miles NW of Cajamarca	2745	Peru	0640S	7845
Chulumani	2750	Bolivia	1628S	6737
Chusmisa, Tarapacá	3170	Chile	1941S	6911
Coast Range W. of Popayán, Cauca	3390	Colombia	0243N	7652
Coast Range W. of Popayán, Cauca	3400	Colombia	0243N	7652

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
Cocal, W. Popayán, Cauca	2500	Colombia	0231N	7700
Cocapata	2200	Bolivia	1657S	6643
Cochabamba	1667	Bolivia	0629S	7854
Cochabamba, Cochabamba	2550	Bolivia	1724S	6609
Colalao del Valle, Tucumán	2500	Argentina	2622S	6557
Colomi, Cochabamba	3075	Bolivia	1721S	6552
Colonia Tovar, Aragua	1900	Venezuela	1023N	6717
Colonia Tovar, Aragua	1930	Venezuela	1025N	6717
Conejos, Mérida	3000	Venezuela	0850N	7115
Conyacota (=Miligalli?)	1800	Ecuador	0016S	7836
Copas, La Rebancha, Táchira	2300	Venezuela	0728N	7221
Corazón	2750	Ecuador	0032S	7839
Cordill. Tolima, Bogotá		Colombia	0440N	7519
Cordillera Cotan E of La Peca, ridge W, Amazonas	2900	Peru	0534S	7817
Cordillera Guamués, Nariño	3400	Colombia	0055N	7704
Cordillera Pax		Colombia	0323N	7726
Cordillera Salta	3500	Argentina	2453S	6533
Cordillera Vilcabamba, Cuzco	1730	Peru	1238S	7329
Cordillera Vilcabamba, Cuzco	2100	Peru	1238S	7325
Cordillera Vilcabamba, Cuzco	2250	Peru	1239S	7334
Cordillera Vilcabamba, Cuzco	2640	Peru	1237S	7328
Cordillera Vilcabamba, Cuzco	2830	Peru	1232S	7326
Cruz Blanca, 33 km by road SW Huancabamba	2900	Peru	0520S	7932
Cubiro, Lara	1800	Venezuela	0947N	6935
Cuenca	2535	Ecuador	0253S	7859
Cuenca Road	2535	Ecuador	0253S	7859
Culata, Mérida	3000	Venezuela	0842N	7106
Cullcui, Marañón River	3170	Peru	0923S	7642
Culumachay, Maraynioc, Junín	2950	Peru	1122S	7525
Cumbaja, 6mi. NE of Quito	2450	Ecuador	0012S	7826
Cumbal, Nariño	3032	Colombia	0054N	7747
Cumbre de Valencia, Carabobo	1700	Venezuela	1020N	6800
Curso de Campo, Virolín		Colombia	0605N	7312
Curupao, Miranda	1200	Venezuela	1031N	6638
Cutervo	2649	Peru	0622S	7851
Cutervo, Cajamarca	2649	Peru	0623S	7853
Cuyujúa, Napo	2400	Ecuador	0024S	7802
Cuzco	3400	Peru	1331S	7159

D-E

Delicias, Páramo Tamá, Táchira	2340	Venezuela	0734N	7225
E slope Cord Lagunillas, ca 25 km road SSE Jimbura, Zamora	3050	Ecuador	0450S	7920
El Castillo (near Santo Domingo de Los Colorados), Pichincha		Ecuador	0002S	
El Cedro, Santa Cruz, Cajamarca	2530	Peru	0649S	7905
El Crucero, Cauca	3200	Colombia	0223N	7639
El Edén, E. Quindio, Tolima	2700	Colombia	0430N	7520
El Escorial, Mérida	2500	Venezuela	0840N	7104
El Escorial, Mérida.	3000	Venezuela	0841N	7104
El Junquito, Caracas, Dto. Federal	2100	Venezuela	1028N	6705
El Líbano, Santa Marta	1850	Colombia	1110N	7400
El Loro, Mérida	4000	Venezuela	0840N	7055
El Mamón, 4 miles above San Sebastián, Sierra de Santa Marta	2100	Colombia	1037N	7333

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
El Misti,near Arequipa	4600	Peru	1618S	7124
El Molle, Valle del Elqui		Chile	3212S	7127
El Peñón (above Fusagasuga)	3150	Colombia	0426N	7418
El Peñón (above Fusagasugá), Cundinamarca	3150	Colombia	0426N	7416
El Pongo, Yungas	3650	Bolivia	1620S	6756
El Portete de Cajanuma, Loja	2525	Ecuador	0405S	7912
El Portete de Tarquí, Azuay	2800	Ecuador	0306S	7906
El Portete de Tarquí, Cuenca	2800	Ecuador	0306S	7906
El Roble, above Fusagasugá	2620	Colombia	0423N	7418
El Salto, Viña del Mar	0	Chile	3323S	7038
El Sauce, Freisina	300	Chile	2849S	7120
El Tambo, Munchique, Cauca	2360	Colombia	0227N	7656
El Tambo, Piura	2865	Peru	0520S	7939
El Tambo, Piura	3000	Peru	0520S	7930
El Valle, Mérida	2200	Venezuela	0840N	7105
Escorial, Mérida	3000	Venezuela	0838N	7105
Estera Ruana, Ayacucho	1900	Peru	1243S	7351
F-G				
Finca Salo (Oploca), Potosí	3600	Bolivia	2119S	6546
Fuerte de Andalgala, Catamarca	1060	Argentina ?	2736S	6619
Fusagasuga	1746	Colombia	0421N	7422
Fusagasugá, Cundinamarca	1850	Colombia	0421N	7422
Galipán, Cerro del Avila	1600	Venezuela	1033N	6653
Guachanama, Loja	2600	Ecuador	0402S	7953
Guaillabamba	1900	Ecuador	0001S	7821
Guaillabamba	1900	Ecuador	0001S	7821
Guaillamba	1900	Ecuador	0001S	7821
Guaillamba	1900	Ecuador	0001S	7821
Gualea, Pichincha		Ecuador	0007N	7850
Guarumo, Pichincha		Ecuador	0004S	7838
H				
Hacienda Jalancay, Chunchi, Chimborazo	1800	Ecuador	0217S	7855
Hacienda La Ilusión, Río Urao, base of Páramo Frontino, Antioquia	2930	Colombia	0625N	7605
Hacienda La Laguna, Andahueylos, Apurímac	3040	Peru	1338S	7319
Hacienda La Llagueda, NE of Otusco	1980	Peru	0746S	7835
Hacienda La Providencia, Río Chiquito, Táchira	1800	Venezuela	0734N	7218
Hacienda La Providencia, Río Chiquito, Táchira	2200	Venezuela	0734N	7223
Hacienda Las Vegas, Santander	1970	Colombia	0740N	7250
Hacienda Potreros, 15 miles SW Frontino, Río Herradura,	2000	Colombia	0639N	7609
Hacienda Río Negro, Río Pastaza	1300	Ecuador	0124S	7813
Hacienda Taulis, Cajamarca	2450	Peru	0650S	7910
Hacienda Turubamba	2900	Ecuador	0021S	7832
Hacienda Victoria, Quebrada Matara, Apurímac	2135	Peru	1349S	7248
Hacienda Vista Nieve, cumbre, Santa Marta	2300	Colombia	1105N	7405
Hacienda Zulaiba, 17 miles NE Santa Rosa de Osos, Antioquia	2790	Colombia	0650N	7528
Haut Pastaza, Env. de Baños		Ecuador	0118S	7805
Hda. Hugro, between Huayopata and Quillabamba, Cuzco	2000	Peru	1258S	7236
Hda. La Capilla, 20km N of Popayan, Cauca	2000	Colombia	0235N	7636
Hichuloma, Yungas de La Paz	3550	Bolivia	1618S	6754

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
Higos, Ajuarcho, Huanta?		Peru	1230S	7410
Huacamayo ridge, ca 8 km S Cosanga, Napo	2200	Ecuador	0034S	7752
Huaisampillo, Cuzco	2950	Peru	1313S	7125
Huamachuco, La Libertad	3650	Peru	0748S	7804
Huancabamba, Piura	1895	Peru	0514S	7928
Huancabamba, Tambo, Piura		Peru	0640S	7845
Huancapata, Panoa regio, Huánuco	2990	Peru	0950S	7600
Huánuco Mts	4050	Peru	0955S	7614
Huaracondo Cañón	3050	Peru	1320S	7215
Huila		Ecuador	0003N	7853
Huilca (West of Macas)	1225	Ecuador	0219S	7807
Idma, above Sta. Ana, Urubamba Valley, Cuzco	1524	Peru	1253S	7249
I-J-K-L				
Incachaca, Cochabamba	2700	Bolivia	1714S	6549
km 126 on Cospiñata Hwy. Pillahuata, Cuzco	2500	Peru	1308S	7125
km 30 road to San Ignacio, Huancabamba	3000	Peru	0514S	7928
La Africa, Sierra Perijá, Magdalena	1900	Colombia	1032N	7256
La Aguadita, Cundinamaca		Colombia	0425N	7420
La Bodega, N side of Río Negrito, Antioquia	1750	Colombia	0542N	7507
La Calera, Cundinamarca	2718	Colombia	0432N	7358
La Candela, 10 miles SW of San Agustín, Huila	2300	Colombia	0150N	7620
La Cocha, Cajamarca, Piura	3150	Peru	0534S	7915
La Compañía Coquimbo	0	Chile	2952S	7116
La Cruz (Quillota)	100	Chile	3250S	7114
La Cruz. Fdo. Sta. Ana, Valparaíso		Chile	3250S	7114
La Culata, Mérida	4000	Venezuela	0848N	7109
La Culata, Mérida	4400	Venezuela	0845N	7105
La Dorada	2500	Colombia	0527N	7425
La Florida, W. of Popayán, Cauca	2520	Colombia	0235N	7655
La Hechicera, Mérida	3000	Venezuela	0834N	7106
La Lejía, Chachapoyas	3000	Peru	0608S	7729
La Lejía, Chachapoyas	2950	Peru	0610S	7713
La Leonera, Caldas	3600	Colombia	0505N	7520
La Paz		Bolivia	1630S	6809
La Playa, San Martín	2610	Peru	0744S	7737
La Raya	4314	Peru	1429S	7105
La Unión, Huánuco	3204	Peru	0946S	7648
La Vega, Vda. El Roble	2400	Colombia	0423N	7419
La Victoria, Nariño	3200	Colombia	0055N	7713
Labramarca, Cuzco	4000	Peru	1342S	7119
Laderas de Yantuma, Ayabaca, Piura	2750	Peru	0441S	7930
Laguna Pedropalo, Santander	2010	Colombia	0445N	7424
Laguneta	2300	Colombia	0432N	7530
Laguneta	2300	Colombia	0432N	7528
Laguneta	3280	Colombia	0432N	7531
Laguneta, Caldas	3280	Colombia	0435N	7530
Laguneta, W. Quindio, Cauca	3380	Colombia	0435N	7530
Lake Papallacta, Napo	3540	Ecuador	0024S	7811
Lampa, Santiago	450	Chile	3317S	7054
Lara, Tucumán	4000	Argentina	2623S	6549
Las Bombas, Chañarol		Chile	2602S	7027
Las Carpas, Cajamarca, Valle del Río Saña	1950	Peru	0659S	7909
Las Cenizas, Valparaíso	0	Chile	3312S	7132
Las Cruces, Cauca	2200	Colombia	0330N	7640

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
Las Delicias, Páramo Tamá	2400	Venezuela	0734N	7225
Las Palmas, Azuay	2500	Ecuador	0237S	7837
Las Quinuas, Libertad		Peru	0704S	7803
Las Trojas, 45 km S Cabudare, Lara	1500	Venezuela	0955N	6918
Las Ventanas, Santander		Colombia	0748N	7306
Leimabamba, Amazonas	2135	Peru	0641S	7747
Leimabamba, Amazonas	3320	Peru	0642S	7752
Levanto	2900	Peru	0616S	7801
Limbani, Carabaya, Puno	3115	Peru	1407S	6945
Llama	2095	Peru	0631S	7907
Llanganates	4689	Ecuador	0113S	7815
Lloa, Pichincha	3577	Ecuador	0015S	7835
Llolleo	0	Chile	3337S	7137
Llorente, Nariño	3200	Colombia	0051N	7719
Llorente, Nariño	1700	Colombia	0047N	7714
Lluy, Amazonas	3280	Peru	0645S	7749
Locotal, Cochabamba	1775	Bolivia	1711S	6548
Loja, Loja	2300	Ecuador	0400S	7913
Los Chochos, ca 25 km NNE Pataz, San Martín	3300	Peru	0744S	7737
Los Conejos, Mérida	3000	Venezuela	0850N	7115
Los Conejos, Mérida	3000	Venezuela	0848N	7112
Los Duraznos, Mérida	1500	Venezuela	0836N	7108
Los Maiteines, Limache (Papudo)	150	Chile	3259S	7115
lower W side of Corazón	4791	Ecuador	0033S	7842
lower W side of Pichincha		Ecuador	0010S	7833
lower W side of Pichincha		Ecuador	0010S	7833
Luracatao, Salta	3500	Argentina	2505S	6625
M				
M. Sierra, Mérida	3000	Venezuela	0833N	7103
Macate	3200	Peru	0846S	7805
Macchu Picchu (Cechobamba)	3660	Peru	1305S	7233
Main valley, S side Río Guatapurí, Sierra Santa	3280	Colombia	1047N	7327
Malrasá, Cauca	3000	Colombia	0229N	7618
Maraiviña, Azuay	3000	Ecuador	0309S	7859
Marangani, Cuzco valley	4300	Peru	1421S	7110
Maraynioc, Junín	4260	Peru	1122S	7524
Marcapata, Quispicanchis		Peru	1330S	7055
Maspa	2600	Ecuador	0025S	7801
Matucana		Peru	1151S	7624
Medellín, Antioquia	1538	Colombia	0615N	7535
Mendoza	964	Argentina	3253S	6849
Mera, Pastaza	1140	Ecuador	0128S	7801
Mera, Río Pastaza, Pastaza	1140	Ecuador	0128S	7808
Mérida, Mérida	1641	Venezuela	0838N	7105
Mérida, Mérida	4000	Venezuela	0836N	7108
Mérida, Mérida		Venezuela	0835N	7108
Mesa de Lino, Santo Domingo	2700	Venezuela	0850N	7045
Millagalli		Ecuador	0016S	7836
Mindo, Quito	1264	Ecuador	0002S	7848
Mindo, Quito		Ecuador	0016S	7836
Mindo-Gualea	1550	Ecuador	0007N	7850
Mojanda Abajo, Pichincha/Imbabura		Ecuador	0008N	7817
Molinopampa, Amazonas	2407	Peru	0610S	7735
Molleturo	3250	Ecuador	0248S	7926

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
Monte (Alto) Socorro, West Cordiller.	3500	Colombia	0635N	7455
Monte Elias, SE of Fonseca, Sierra Negra, Magdalena	1700	Colombia	1051N	7243
Moscopan, Cauca	2000	Colombia	0542N	7507
Moscopan, Cauca	2300	Colombia	0220N	7605
Mt Pichincha		Ecuador	0010S	7833
Mt Pichincha		Ecuador	0010S	7833
Munchique, El Tambo, Cauca	1970	Colombia	0225N	7649
N Río Isimanchí, ca 6 km NW San Andrés, Zamora-Chichipe	2250	Ecuador	0447S	7920
Nanegal		Ecuador	0070N	7840
Napo Fluss, Oberlauf		Ecuador	0110S	7815
Naranjal to Cuenca	3320	Ecuador	0248S	7902
near Quito	2818	Ecuador	0013S	7830
Ñequejahuira, La Paz	2600	Bolivia	1620S	6750
Nevado del Huila, Páez, Cauca		Colombia	0300N	7600
Nevado del Tolima, Tolima	3200	Colombia	0440N	7519
Nevados, Mérida	3000	Venezuela	0845N	7050
Nevados, Mérida	3000	Venezuela	0836N	7108
N-O				
Nonopungo, Pichincha		Ecuador	0004S	7833
North Quito	2818	Ecuador	0013S	7830
Oconeque, Puno		Peru	1408S	6941
Ollantaytambo	2846	Peru	1316S	7216
Olmué (Limache), Valparaíso		Chile	3301S	7116
on Quillabamba Rd. Above San Luis, Cuzco	3300	Peru	1306S	7225
Oroya, Rio Mantaro		Peru	1132S	7554
Oyacachi	2500	Ecuador	0015S	7757
Oyacachi	2500	Ecuador	0016S	7758
Oyacachi, Napo	2500	Ecuador	0015S	7757
P-Q				
Pacho (Las Palmas), Bogotá	2500	Colombia	0509N	7408
Pagma forest, Chunchi, Chimborazo		Ecuador	0217S	7859
Paichigal, Río Tambillo		Ecuador	0024S	7831
Palambla, Piura	1310	Peru	0523S	7937
Palca, Tacna	3000	Peru	1748S	6957
Paletará, Popayán	3000	Colombia	0210N	7626
Pallatanga, Chimborazo	1500	Ecuador	0201S	7859
Palo Gordo, 10 miles SE Villa Felisa-Tachira Valley, San	1520	Colombia	0740N	7231
Panamá, above Pacho, Cundinamarca	2100	Colombia	0508N	7413
Panguri, ca 12km NE San Francisco del Vergel, Zamora- Chichipe	1600	Ecuador	0437S	7858
Papallacta	3149	Ecuador	0022S	7808
Papallacta		Ecuador	0222S	7824
Papallacta Abajo, Napo		Ecuador	0022S	7808
Papallacta-Baños	3149	Ecuador	0022S	7808
Papallacta-Baños		Ecuador	0222S	7808
Papudo, Aconcagua	20	Chile	3231S	7127
Páramo de La Culata	3000	Venezuela	0848N	7109
Páramo de La Culata	3000	Venezuela	0845N	7105
Páramo de La Culata	4000	Venezuela	0847N	7107
Páramo de Tama (Camp), Táchira	2400	Venezuela	0725N	7226

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
Páramo de Tamá, Táchira	1825	Venezuela	0725N	7226
Páramo de Tamá, Táchira	1825	Venezuela	0728N	7228
Páramo del Morro, Mérida	3000	Venezuela	0833N	7103
Páramo Frontino, Antioquia	3890	Colombia	0628N	7604
Páramo Guamués, Nariño	3400	Colombia	0055N	7704
Páramo Sonsón, Antioquia		Colombia	0543N	7515
Páramos de Bogotá		Colombia	0436N	7405
Path to Páramo Tamá, Táchira	2490	Venezuela	0725N	7226
Paucartambo	2906	Peru	1318S	7146
Paucartambo, Cuzco	3000	Peru	1319S	7135
Pedropalo	2010	Colombia	0445N	7424
Pichán, Pichincha	3500	Ecuador	0002N	7840
Pichincha	4875	Ecuador	0010S	7833
Pichincha		Ecuador	0010S	7836
Pichincha Mt.		Ecuador	0010S	7836
Pico Guacamayo, above Rancho Grande, Aragua	1800	Venezuela	1024N	6735
Pie SE Cerro Tetari, Perijá, Zulia	2900	Venezuela	1002N	7302
Pinos, Mérida	3000	Venezuela	0836N	7117
Pisac	2972	Peru	1326S	7151
Poopó, Sud	3700	Bolivia	1823S	6659
Popayán, Cauca	1750	Colombia	0227N	7636
Porculla, Lambayaque	1700	Peru	0552S	7932
Portete, Loja		Ecuador	0306S	7906
Pueblo Viejo, Oyacachi abajo	2500	Ecuador	0015S	7757
Puente del Río Quijos, Napo		Ecuador	0014S	7743
Puno		Peru	1550S	7202
Puracé, Cauca	2990	Colombia	0224N	7623
Puracé, km 11, Cauca	2950	Colombia	0224N	7627
Putre, Tacna	3550	Chile	1801S	7015
Quebrada Miraflores, Pichincha		Ecuador	0026S	7833
Queniquea, Táchira	1600	Venezuela	0755N	7201
Queñuani. Azúngaro, Puna		Peru	1450S	7010
Quillota	128	Chile	3253S	7116
Quintero, Mérida	2800	Venezuela	0840N	7100
Quito	2818	Ecuador	0013S	7830
Quito, Pichincha	2810	Ecuador	0013S	7838
Ramírez, Santander	2000	Colombia	0748N	7305
Rantún, Tungurahua		Ecuador	0126S	7824
Río Aguacatal, Huíla	1800	Colombia	0216N	7601
Rio Jelache, San Martin	1373	Peru	0644S	7731
Río Mucujún, Mérida	2950	Venezuela	0836N	7109
Río Napo, Napo		Ecuador	0110S	7815
Río Oyacachi Abajo, Chaco	2500	Ecuador	0019S	7747
Río Pilcomayo, Sucre		Bolivia	2104S	6403
Río Toche, E. Quindio,Tolima	2100	Colombia	0426N	7522
Río Toche, Paso del Quindío	2100	Colombia	0438N	7532
Río Totora, 15 km N. Monte Punco, Cochabamba	1700	Bolivia	1724S	6509
Riobamba, Chimborazo	2754	Ecuador	0140S	7838
R-S				
Runtún, near Baños	2000	Ecuador	0120S	7825
S. of trail from Logroño to Yaupi	1975	Ecuador	0231S	7816
Salento, Caldas	2300	Colombia	0438N	7534
Salento, W. Quindío	2300	Colombia	0438N	7534
Salento, W. Quindio, Cauca	2100	Colombia	0439N	7536

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
Salvias, Zaruma-Zaraguro trail, Prov del Oro	1050	Ecuador	0347S	7921
San Antonio [now Gamboa], Cauca	2300	Colombia	0330N	7638
San Antonio de Galipán, Dto. Federal	1600	Venezuela	1033N	6653
San Antonio, Cauca	2160	Colombia	0330N	7638
San Antonio, Cauca	2500	Colombia	0237N	7654
San Antonio, West Cordiller.	2100	Colombia	0717N	7546
San Antonio, Yungas		Bolivia	1623S	6646
San Bartolo, Alamor Range, Loja	2500	Ecuador	0402S	7955
San Ignacio, Pichincha	3700	Ecuador	0023S	7831
San José de Maipo, Santiago	1000	Chile	3327S	7040
San Lorenzo, Santa Marta	2250	Colombia	1110N	7407
San Lorenzo, Santa Marta	2250	Colombia	1110N	7401
San Lucas to Loja	3000	Ecuador	0344S	7913
San Miguel, Macchu Picchu, Urubamba, Cuzco	1640	Peru	1306S	7238
San Miguel, Santa Marta	1700	Colombia	1058N	7329
San Pedro de Taboada	2700	Ecuador	0019S	7828
San Pedro village, Cuzco-Shintuya highway	1500	Peru	1309N	7124
San Pedro, Chachapoyas, Amazonas	2290	Peru	0637S	7741
San Rafael, Purocé, Cauca	3375	Colombia	0225N	7625
San Vicente, between Gualaceo and General L. Plaza Guiérrez, Morona-Santiago	2700	Ecuador	0300S	7832
Santa Elena, Antioquia	2750	Colombia	0613N	7510
Santa Fe de Bogotá		Colombia	0436N	7405
Santa Isabel, Quindio	3930	Colombia	0447N	7528
Santa Rita, Cañón Urubamba, Cuzco		Peru	1311S	7237
Santo Domingo	500	Ecuador	0115S	7909
Santo Domingo de Los Colorados	1200	Ecuador	0015S	7909
Santo Domingo de Los Colorados	1200	Ecuador	0115S	7909
Sebucán, Cerro El Ávila	1600	Venezuela	1031N	6650
Seques, NE Pacasmayo	1660	Peru	0654S	7909
Sierra de Mérida	3000	Venezuela	0833N	7103
Sierra de Mérida, Mérida	3000	Venezuela	0834N	7106
Silla de Caracas, Miranda		Venezuela	1033N	6651
Sillunticara		Bolivia	1617S	6754
Simínchucua, Sierra de Santa Marta	2550	Colombia	1040N	7338
Soquian, Libertad	2590	Peru	0751S	7741
Subia, near La Mesa, Cundinamarca	1900	Colombia	0432N	7425
Succha, Huamachuco	2745	Peru	0754S	7741
Sumaco Abajo; Napo		Ecuador	0034S	7738
Sumaco Arriba	3800	Ecuador	0033S	7738
Sumaco Arriba		Ecuador	0034S	7738
Tambillo	2785	Ecuador	0025S	7832
Tambo Pata, Yungas of Cochabamba	2900	Bolivia	1623S	6646
Tambor, Mérida	3000	Venezuela	0836N	7124
Tamiapampa	2760	Peru	0620S	7801
Taraguacocha, Zaruma-Zaraguro trail, Cord de Chila	3400	Ecuador	0333S	7934
Tarma, Junín	3600	Peru	1125S	7542
Taulís, NE of Pacasmayo	2670	Peru	0654S	7903
Tena, Laguna	2010	Colombia	0445N	7424
Terepaima, Lara	1250	Venezuela	0957N	6916
Termales, Tolima	2400	Colombia	0429N	7533
Termales, Tolima	2970	Colombia	0447N	7533
Tica-Tica, near Cuzco	3510	Peru	1330S	7203

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
Tierra Nueva, SE of Fonseca, Sierra Negra, Magdalena	1700	Colombia	1035N	7245
Tijeras (Moscopan), Cauca	2750	Colombia	0221N	7614
Tílcara, Jujuy	2470	Argentina	2334S	6522
Tinta	3466	Peru	1409S	7125
Tireque, Cochabamba	3400	Bolivia	1725S	6543
Toche, Tolima	2400	Colombia	0432N	7525
Tofo		Chile	2927S	7115
Tojo, 128 km SW Tarija	2600	Bolivia	2131S	6545
Topo Gallinero, Palmira, Táchira	2000	Venezuela	0752N	7214
Torontoy	2620	Peru	1310S	7231
Totora, Cochabamba	2600	Bolivia	1742S	6509
Trail to Hda. Paty, below Carpish Pass, Huánuco	2470	Peru	0938S	7608
T-U				
Tulcán, Carchi	2956	Ecuador	0048N	7743
Tumbaco	2400	Ecuador	0013S	7824
Uscho, Amazonas		Peru	0611S	7713
Uscho, Chachapoyas, ab. 50 miles, Amazonas	1525	Peru	0618S	7713
Utcubamba, Libertad	1830	Peru	0816S	7702
Utcuyacu, Junín	1465	Peru	1112S	7528
Vacas, Cochabamba	3000	Bolivia	1732S	6535
Valdivia, above Sevilla, Antioquia	1300	Colombia	0709N	7528
Valle de Mérida		Venezuela	0836N	7108
Valle de Rojas		Ecuador	0013S	7826
Valle Tumbaco	2900	Ecuador	0013S	7824
Valley of Chillo, near Quito		Ecuador	0016S	7829
Valparaíso	0	Chile	3302S	7138
Verdecocha, Pichincha	2850	Ecuador	0005S	7837
Vía Zamora, Loja		Ecuador	0404S	7858
Vila Vila	2300	Bolivia	1758S	6535
Vilcanota, Cuzco	3000	Peru	1426S	7057
Villa Páez, Páramo Tamá, Táchira	2500	Venezuela	0730N	7228
Viña del Mar	0	Chile	3302S	7134
Virolín, 28 km S of Charolá-Duitamard	1800	Colombia	0605N	7312
Virolín, Loma del Rey		Colombia	0605N	7312
Volcán Pichincha	3300	Ecuador	0010S	7836
V-W				
W Corazón		Ecuador	0032S	7839
W side of Quito		Ecuador	0013S	7830
W slope Cerro Mongus, ca 3 km SE Impueran, Ca	3350	Ecuador	0027N	7752
W slope Cerro Mongus, ca 3 km SE Impueran, Ca	3400	Ecuador	0028N	7754
W slope Cord Lagunillas, 9 km SSE Jimbura, Loja	2650	Ecuador	0437S	7930
W slope, near road betw Maldonado & Tulcán along Río La Plata, Carchi	2525	Ecuador	0048S	7802
W slope, S of road btw Maldonado & Tulcán, S and above	3100	Ecuador	0047N	7801
W. Quindio, above Salento, Quindío	2950	Colombia	0438N	7528
Yaraceyacu, Ayacucho	2600	Peru	1247S	7352
Yava Urcu, Azuay	3300	Ecuador	0332S	7904
Yugay, Ancash	2335	Peru	0909S	7744
Yungas of Cochabamba, Cochabamba	2900	Bolivia	1623S	6646
Yungas Ranges of Sillunticara	3930	Bolivia	1619S	6756
Yungas, Chaco, La Paz		Bolivia	1620S	6748

LOCALITY	ALTITUDE	COUNTRY	LAT.	LONG.
X-Y-Z				
Zamora	3000	Ecuador	0407S	7905
Zamora Huaico, Loja	2800	Ecuador	0400S	7913
Zapallar, Aconcagua	0	Chile	3233S	7128
Zuña, Río Upano, Morona-Santiago	2300	Ecuador	0212S	7816

Erklärung

Hiermit erkläre ich, dass die vorliegende Dissertation einschließlich beigefügter Zeichnungen, Kartenskizzen und Darstellungen von mir selbständig angefertigt wurde. Andere als die angegebenen Hilfsmittel wurden nicht verwendet. Alle Stellen der Arbeit, die dem Wortlaut oder dem Sinn nach anderen Werken entnommen sind, habe ich in jedem Fall unter Angabe der Quelle deutlich als Entlehnung kenntlich gemach.

Hiermit erkläre ich auch, dass diese Arbeit unter der Leitung von Herrn Professor Dr. K.-L. Schuchmann und Herrn Dr. W. Böhme als Korreferenten selbst und ohne jede unerlaubte Hilfe angefertigt habe, dass diese oder eine ähnliche Arbeit noch keiner anderen Stelle zur Prüfung vorgelegen hat und dass sie weder vollständig noch auszugsweise veröffentlicht worden ist.

Bonn, 15. September 2003.

Carlos Sánchez Osés