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DNA-sequence data require revision of the parrot genus *Aratinga* (Aves: Psittacidae)

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The genus *Aratinga* von Spix, 1824, as treated since Peters (1937), consists of 20 to 21 species (Kremer 1989, Collar 1997, Juniper & Parr 1998, Silveira *et al.* 2005, Dickinson 2003, Forshaw 2010) of medium-sized, pointed-tailed, mostly green parakeets that range throughout the Neotropical region. All species currently included in the genus *Aratinga* had already been recognized by Salvadori (1891) and placed in the genus *Conurus*. Ridgway (1916) placed the species in four genera: *Aratinga*, *Eupsittula*, *Nandayus*, and *Thectocercus*; Ridgway provided a rationale for his treatment using morphological and plumage characters, and he included a dichotomous key. Cory (1918) followed Ridgway's (1916) classification. Miranda-Ribeiro (1920) placed the species in four genera: *Conurus*, "*Nendayus*" (=*Nandayus*), *Gymnopsittacus*, and "*Eupsittacula*" (=*Eupsittula*). Peters (1937) placed all members of these genera but *Nandayus nenday* into a single genus, *Aratinga* (Table 1), but provided no rationale for his classification. Nonetheless, his treatment has been followed in all subsequent classifications, including Meyer de Schauensee (1970), Sibley & Ahlquist (1990), Collar (1997), Dickinson (2003), and Forshaw (2010), although Marien & Koopman (1955) suggested retention of three subgenera.

Ribas & Miyaki's (2004) results called into question the monophyly of Peters' broadly defined *Aratinga* when they found that *A. leucophthalma* was only distantly related to the other *Aratinga* sampled and that *Nandayus nenday* was embedded within the sampled *Aratinga* species. Silveira *et al*. (2005) provided additional details delimiting at least three groups within broadly defined *Aratinga* (see also Whitney 1996) and proposed that it was not a monophyletic genus. These three groups also show consistent difference in vocalizations among the groups and similarities among species within each group (B. M. Whitney, pers. comm.). Subsequent studies with much broader taxon sampling (Kirchman *et al.* 2012, Schirtzinger *et al.* 2012) confirmed that the genus consisted of three separate lineages, corresponding in part to the 3-genus classification of Ridgway (1916) and Pinto (1938). Further, Ribas & Miyaki (2004) and Tavares *et al.* (2006) found that the monotypic genus *Nandayus* was embedded in one of the *Aratinga* lineages. Subsequently, Urantowka *et al.* (2012) also found that *Aratinga* species were distributed in the three clades found by previous authors, but also found that *A. acuticaudata* was even more distantly related to the other *Aratinga* and was actually the sister species to *Diopsittaca nobilis*.

These new data require that *Aratinga* sensu Peters (1937) be partitioned into four genera. The type species (by subsequent designation) for *Aratinga* is *solstitialis* Linnaeus, 1758. Two species have traditionally been considered closely related to *A. solstitialis*: *A. jandaya* and *A. auricapillus*. In fact, Meyer de Schauensee (1966), Sick (1993), and others considered them conspecific, and Sibley & Ahlquist (1990) treated them as members of a superspecies. Ribas & Miyaki (2004) included *solstitialis* in their taxon sampling, but Silveira *et al.* (2005) noted that the specimens used were actually of a taxon that they described as a new species, *Aratinga pintoi*. Subsequently, Nemésio and Rasmussen (2009) determined that *A. pintoi* had been previously described as *Psittacus luteus* Boddaert, 1783, which is, in turn, synonym of *Psittacus maculatus* (=*Aratinga maculata*) Statius Muller, 1776, a name that had been relegated to the synonymy *A. solstitialis* and had been overlooked by subsequent authors, including Peters (1937). The plumage characters associated with *maculata* had been dismissed as age variation in *A. solstitialis*, aviary artifacts, or hybrids by everyone except Pinto (1966), until Silveira *et al.* (2005) showed that they represented discrete characters that defined a geographical representative of the *A. solstitialis* group. Therefore, we think it is reasonable to include *A. maculata* in *Aratinga* sensu stricto. Tavares *et al.* (2006) included *solstitialis* in their sampling, but did not provide information on their vouchers and

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did not cite Silveira *et al.* (2005); thus whether their specimen was true *solstitialis* or *maculata* is uncertain. Kirchman *et al.* (2012) included true *solstitialis* (fide G. R. Graves corroboration of identification of the voucher specimen, USNM 614252) in their sampling, however, and its phylogenetic position there was consistent with that in Ribas & Miyaki (2004), who found that the species *jandaya* and *auricapillus* were closely related to *maculata* and that these three formed a clade to which *Nandayus nenday* and *A. weddellii* were successive sisters. Therefore, *jandaya* and *auricapillus* may be safely retained in *Aratinga*. *Nandayus nenday* has been placed in a monotypic genus largely because of its black crown and elongated upper mandible, but structurally and in other aspects of its plumage, it seems not only to be a typical *Aratinga*, where placed by Short (1975), but also a member of this species group (Silveira *et al.* 2005). One additional species almost certainly also belongs in this group: *Aratinga weddellii* grouped with these species in Ribas & Miyaki (2004) and shares with all species in this group the distinctive and diagnostic coloration pattern of the rectrices and primaries, and black bill, as outlined by Silveira *et al.* (2005); it is also allopatric to the other members of the group. *Aratinga* as thus narrowly constituted consists of six allopatric or parapatric taxa restricted to lowland tropical and subtropical South America. An unresolved question is whether the extinct *Conuropsis carolinensis* should be included within this group. *Kirchman et al.* (2012) found it to be sister to the clade composed of *A. solstitialis*, *A. auricapillus* and *N. nenday* based on molecular characters. They did not, however, sample *A. jandaya* or *A. weddellii*, so it remains uncertain whether *C. carolinensis* belongs within the newly circumscribed genus *Aratinga* or is sister to it.

TABLE 1. History of generic assignment of currently (Dickinson 2003) recognized species in broadly defined *Aratinga*. Species names and sequence as in Dickinson (2003). Blank cells represent taxa not treated in that reference.

SPECIES	Salvadori (1891)	Miranda-Ribeiro (1920)	Ridgway (1916)	Cory (1918)	Peters (1937)	Pinto (1938)	Dickinson (2003)
acuticaudata	*Conurus*	*Conurus*	*Thectocercus*	*Thectocercus*	*Aratinga*	*Psittacara*	*Aratinga*
holochlora	*Conurus*		*Aratinga*	*Aratinga*	*Aratinga*		*Aratinga*
strenua			*Aratinga*	*Aratinga*	*Aratinga*		*Aratinga*
wagleri	*Conurus*		*Aratinga*	*Aratinga*	*Aratinga*		*Aratinga*
mitrata	*Conurus*			*Aratinga*	*Aratinga*		*Aratinga*
erythrogenys				*Aratinga*	*Aratinga*		*Aratinga*
finschi	*Conurus*		*Aratinga*	*Aratinga*	*Aratinga*		*Aratinga*
leucophthalma	*Conurus*	*Conurus*		*Aratinga*	*Aratinga*	*Psittacara*	*Aratinga*
euops	*Conurus*		*Aratinga*	*Aratinga*	*Aratinga*		*Aratinga*
chloroptera	*Conurus*		*Aratinga*	*Aratinga*	*Aratinga*		*Aratinga*
solstitialis	*Conurus*	*"Nendayus"*	*Eupsittula*	*Eupsittula*	*Aratinga*	*Aratinga*	*Aratinga*
jandaya	*Conurus*	*"Nendayus"*	*Eupsittula*	*Eupsittula*	*Aratinga*	*Aratinga*	*Aratinga*
auricapillus	*Conurus*	*"Nendayus"*	*Eupsittula*	*Eupsittula*	*Aratinga*	*Aratinga*	*Aratinga*
weddellii	*Conurus*	*Gymnopsittacus*		*Eupsittula*	*Aratinga*	*Aratinga*	*Aratinga*
nana	*Conurus*		*Eupsittula*	*Eupsittula*	*Aratinga*		*Aratinga*
canicularis	*Conurus*		*Eupsittula*	*Eupsittula*	*Aratinga*		*Aratinga*
aurea	*Conurus*	*"Eupsittacula"*	*Eupsittula*	*Eupsittula*	*Aratinga*	*Aratinga*	*Aratinga*
pertinax	*Conurus*	*Gymnopsittacus*	*Eupsittula*	*Eupsittula*	*Aratinga*	*Aratinga*	*Aratinga*
cactorum	*Conurus*	*Gymnopsittacus*		*Aratinga*	*Aratinga*	*Aratinga*	*Aratinga*
nenday	*Conurus*	*"Nendayus"*	*Nandayus*	*Nandayus*	*Nandayus*	*"Nendayus"*	*Nandayus*

Kirchman *et al.* (2012) found that seven species included in *Aratinga* by Peters (1937) formed a monophyletic group that corresponded to Silveira *et al.*'s (2005) group II. This group is not closely related to true *Aratinga* but rather is the sister to a group that consists of *Leptosittaca branickii*, *Diopsittaca nobilis*, and *Guarouba guarouba*. The species are *leucophthalmus*, *wagleri*, *mitrata*, *holochlora*, *finschi*, *chloroptera*, and *euops*. The oldest genus name available for this group is *Psittacara* Vigors, 1825. Silveira *et al.* (2005) included two other species in this group that were not sampled in the DNA-based studies: *Aratinga strenua* and *A. erythrogenys*. We agree that they can be safely if provisionally also placed in *Psittacara*. *Aratinga strenua* is often treated as a subspecies of *A. holochlora* (e.g., Juniper & Parr 1998), and *A. erythrogenys* is traditionally considered closely related to *A. mitrata* and *A. wagleri* because of similarities in plumage

and size. *Psittacara* also differs from *Aratinga* sensu stricto and *Eupsittula* (see below) in that most component species range high into montane areas, and at least three taxa are exclusively montane (*Psittacara holochlorus brewsteri*, *P. wagleri*, *P. mitratus*).

Silveira *et al.* (2005) also included *Aratinga acuticaudata* in this group, although it had not been included in the DNA-based studies. However, it is the only member of the latter group with red in the rectrices and blue in the crown. Ridgway (1916) placed it in a monotypic genus, *Thectocercus*, because it differed from all *Aratinga* in having: (a) a very wide bill, wider than it was deep; (b) a bill tip that was "attenuated, acute, and ridged"; (c) a cere lacking feathers posterior to nares; and (d) inner webs of rectrices extensively red. However, *acuticaudata* does share the following features with members of the *Psittacara* group, as outlined by Silveira *et al.* (2005): relatively large size compared to other members of broadly defined *Aratinga*; mostly green plumage; large, whitish eyering; pale maxilla; and remiges ventrally yellowish green. Nonetheless, Ferraroni and Silveira (unpubl. data) have found additional morphological characters that reinforce Ridgway's assessment. Finally, Urantowka *et al.* (2012) found that *acuticaudata* was not a member of the *Psittacara* group, and that it was embedded in the *Leptosittaca-Guarouba-Diopsittaca* group. Thus, resurrecting *Thectocercus* for *acuticaudata* is required to maintain monotypic *Psittacara*.

Arndt (2006) described a new species, *Aratinga hockingi*, from the Andes of Peru, and a new subspecies, *A. mitrata tucumana*, from Argentina. He also elevated the Andean taxon *A. mitrata alticola* to species rank. *Aratinga hockingi* and *A. alticola* were noted as differing from *A. mitrata* primarily in the extent of red on the head and thighs, and as differing from each other only in extent of red on forecrown; as noted by Arndt (2006), these characters also show individual and age variation within each taxon. Agnolin (2009) considered *tucumana* to be a synonym of nominate *A. mitrata* because he considered *tucumana* to represent individual variation within Argentine populations of *A. m. mitrata*. Other authors have discussed the issue of plumage variation in broadly defined *Aratinga*, including Blake & Hocking's (1947) on individual and seasonal variation in *Aratinga acuticaudata*, and Marien & Koopman (1955) on individual variation in *Aratinga* in general. Based on this and the seeming unlikelihood that three or four species of *Psittacara* would be sympatric in some Andean valleys, Remsen *et al.* (2012) did not recognize *hockingi* as a valid species or *alticola* as a separate species pending additional corroborating field and lab studies (Ferraroni *et al.*, in prep.). If these taxa are subsequently shown to be valid species, they would also be placed in *Psittacara*.

Kirchman *et al.* (2012) also found that another three species (*pertinax*, *nana*, and *aurea*) included in *Aratinga* by Peters (1937) formed a monophyletic group that was not closely related to true *Aratinga* but rather was the likely sister group, among the genera sampled, to the genus *Rhynchopsitta*. Tavares *et al.* (2006) also found that *A. aurea* was unlikely to be closely related to *A. solstitialis*. Together, these results suggest that *Aratinga*, even without the species assigned above to *Psittacara*, is not monophyletic. Two other species have been linked to this group by molecular studies: Ribas & Miyaki (2004) found that *Aratinga cactorum* was sister to *A. aurea* among the taxa they sampled, and Schirtzinger *et al.* (2012) found that *A. canicularis* was sister to *A. pertinax*. Sick (1993) considered *A. cactorum* to form a superspecies with *A. pertinax*. The oldest genus name available for the group is *Eupsittula* Bonaparte, 1853, for which the type species is *canicularis*.

We recommend that the five species above, the same five identified by Silveira *et al.* (2005) as forming a natural group, be included in a resurrected *Eupsittula*. All five are relatively small species that share grayish or olive breast plumage, and rectrices that are mostly green dorsally and olivaceous ventrally. They also share a similar pattern of coloration in the upper wing coverts: like *Aratinga* (and unlike *Psittacara*) they have blue greater wing coverts, but the blue is paler (reduced to a faint tinge in *cactorum*) and does not extend to the outer primary coverts. All five species are found primarily in semi-humid to dry regions in deciduous forest or scrub and even desert, or if in humid areas, in edge or riverine habitat. They are allopatric except for minor, perhaps recent (B. M. Whitney, pers. comm.) overlap between *E. aurea* and *E. cactorum* in eastern Brazil.

Taxonomic recommendation. We recommend the following reclassification of the species formerly placed in *Aratinga* by Peters (1937):

Aratinga (gender feminine; type species = *solstitialis*)
Aratinga weddellii (Deville, 1851)
Aratinga nenday (Vieillot, 1823)
Aratinga solstitialis (Linnaeus, 1758)
Aratinga maculata (Statius Muller, 1776)
Aratinga jandaya (Gmelin, 1788)
Aratinga auricapillus (Kuhl, 1820)
Eupsittula (gender feminine; type species = *canicularis*)

Eupsittula nana (Vigors, 1830)
Eupsittula canicularis (Linnaeus, 1758)
Eupsittula aurea (Gmelin, 1788)
Eupsittula pertinax (Linnaeus, 1758)
Eupsittula cactorum (Kuhl, 1820)

Thectocercus (gender masculine, thus requiring changes to the endings of adjectival species names; type species = *acuticaudatus*)
Thectocercus acuticaudatus (Vieillot, 1818)

Psittacara (gender masculine, thus requiring changes to the endings of adjectival species names; type species = *leucophthalmus*)
Psittacara holochlorus (Sclater, 1859)
Psittacara strenuus (Ridgway, 1915)
Psittacara wagleri (G.R. Gray, 1845)
Psittacara mitratus (von Tschudi, 1844)
Psittacara erythrogenys Lesson, 1844
Psittacara finschi (Salvin, 1871)
Psittacara leucophthalmus (Statius Muller, 1776)
Psittacara euops (Wagler, 1832)
Psittacara chloropterus Souancé, 1856

Note that species limits in the *Psittacara holochlorus*/*strenuus* group are controversial, in that some classifications treat *strenuus* as a subspecies of *holochlorus* (Juniper & Parr 1998, Forshaw 2010), and others treat *P. h. rubritorquis* and *P. h. brevipes* each as separate species (Collar 1997). We also provide the following simple key to the four genera based on coloration of the greater wing coverts and tail and including some of the characters noted by Ridgway (1916):

A1. Greater wing coverts and tail green: ***Psittacara***.
A2. Greater wing coverts green and tail green with red in the inner webs: ***Thectocercus***.
A3. Greater wing covert with blue or violet, and tail green or olive-green tipped violet: B

B1. Greater primary coverts violet blue, tail olive-green tipped violet: ***Aratinga***.
B2. Greater primary coverts mostly green with some blue (bluish green in *cactorum*) on inner primary coverts, tail green: ***Eupsittula***.

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