

Higher classification of New World parrots (Psittaciformes; Arinae), with diagnoses of tribes

RICHARD SCHODDE¹, J. V. REMSEN, JR. ², ERIN E. SCHIRTZINGER³, LEO JOSEPH¹ & TIMOTHY F. WRIGHT³

¹Australian National Wildlife Collection, CSIRO Ecosystem Sciences, GPO Box 1700, Canberra, ACT 2601, Australia

²Museum of Natural Science & Department of Biological Sciences, Louisiana State University, Baton Rouge, Louisiana 70803, USA.
E-mail: najames@LSU.edu

³Department of Biology, New Mexico State University, Las Cruces, New Mexico 88003, USA

We offer here a diagnosed higher-level classification of New World parrots to reflect relationships inferred from a consensus of recent DNA-based phylogenies and morphological and behavioral studies. General understanding of the position of New World parrots among the Psittaciformes through the later 20th century stems from Smith's (1975) exhaustive review of structural morphology and behavior, which supplanted previous hypotheses (e.g. Verheyen 1956; Boetticher 1959; Brereton 1963; Wolters 1975). In his study, which covered over 54 genera, including 20 of the roughly 31 from the New World (Collar 1997; Dickinson 2003), Smith (1975) concluded that the New World parrots were monophyletic. Moreover, he considered the New World parrots sufficiently divergent from other parrots to be accorded subfamily rank because they share several unique morphological and behavioral characters, including imperforate neonatal ear canals, double-sided "dyck texture" (Dyck 1971) pigmentation of remiges, lack of cutaneous pigmentation, and one-legged copulatory stance.

All studies based on DNA sequence data have subsequently corroborated the monophyly of New World parrots (Miyaki *et al.* 1998, de Kloet & de Kloet 2005, Tokita *et al.* 2007; Wright *et al.* 2008, Schweizer *et al.* 2011, Kirchman *et al.* 2012, Schirtzinger *et al.* 2012). Furthermore, most found them sister to the African psittacine parrots (*Psittacus*, *Poicephalus*), a relationship robustly supported in the two studies with broadest sampling (Schweizer *et al.* 2011, Schirtzinger *et al.* 2012). Sibley and Ahlquist (1990: fig. 361) had earlier recovered the same result from DNA-DNA hybridisation.

Although the timing of divergences within the parrots is hampered by a lack of well-recognized fossil calibrations within crown lineages, the geographic isolation of New World from Old World parrots is almost certainly ancient. Wright *et al.* (2008) calculated two different divergence dates for New World from Old World parrots based on alternative calibrations. One calibration, based on geological dating of the separation of New Zealand from Australia, produced a date of ca. 55 mya (early Eocene) for this split, and the other, based on a fossil of a stem parrot lineage, produced a date of ca. 35 mya (early Oligocene). Schweizer *et al.* (2011) calculated a divergence date for this separation of ca. 30 mya (Oligocene), based on a number of fossil calibrations external to the parrots. Any of these divergence dates would make the New World parrot lineage older than many non-passerine lineages treated as families in traditional classifications.

Joseph *et al.* (2012) expressed the sister relationship of the New World group and the African psittacine parrots by placing them in a family of their own, Psittacidae, in which each was ranked as a subfamily. They also showed that the valid subfamily name for the New World group under the International Code of Zoological Nomenclature (ICZN 1999), hereafter the Code, was Arinae G.R. Gray 1840 (1825), replacing Macrocerinae Vigors, 1825. We accept this classification of relationships and its nomenclature.

Within the Arinae, supra-generic groupings have been varied and contentious, particularly among the early morpho-behavioral reviews. Verheyen (1956) broke them up into the two groups, the attenuate-tailed (macaws, conures and allies) and round-tailed (amazons and allies) parrots, that Salvadori (1891), Thompson (1899), and others had long recognized. Brereton (1963) proposed radically different relationships and combined all New World parrots in a group among the Old World cockatoos and psittaculine parrots (superfamily Cacatuoidea), except for a small cluster comprising the genera *Forpus*, *Psilopsiagon*, and *Bolborhynchus*, a grouping that proved prescient. These last genera he placed as a distinct group among the Australasian lories and broad-tailed parrots, which were themselves part of his larger superfamily Platyceroidea. They share a common form of the temporal fossa and auditory meatus with other members of Brereton's (1963) Platyceroidea, and they scratch-preen the head indirectly, over the wing, not under as in