



New synonym of *Nephus (Nephus) voeltzkowi* Weise (Coleoptera: Coccinellidae), with comments on the origin of a Nearctic population and its possible asexual status

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Coccinellidae (Coleoptera), commonly known as ladybirds or ladybugs, are a highly diversified family comprising nearly 6000 described species (Vandenberg 2002) distributed in 2 subfamilies and 24 tribes (Seago *et al.* 2011). The genus *Nephus* Mulsant, 1846, present worldwide, is currently placed in the vast Coccidulini tribe (Seago *et al.* 2011). There are different classifications for *Nephus*: Gordon (1976, 1985) considered five *Nephus* subgenera (*Depressoscymnus* Gordon, *Nephus* Mulsant, *Scymnobius* Casey, *Sidis* Mulsant, and *Turboscymnus* Gordon), while Fürsch (1987) considered nine *Nephus* subgenera, and later (Fürsch 1996) excluded *Diomus* Mulsant, 1850 as subgenus, leaving *Bipunctatus* Fürsch, 1987, *Depressoscymnus* Gordon, 1976, *Geminosopho* Fürsch, 1987, *Nephus* Mulsant, 1846, *Parascymnus* Chapin, 1965, *Scymnobius* Casey, 1899, *Sidis* Mulsant, 1850 and *Turboscymnus* Gordon, 1976. Gordon and González (2002) elevated *Scymnobius* to genus.

The following characters distinguish *Nephus*: antennae with a different number of antennomeres depending on the subgenus, ranging from 8 to 11; prosternal process sub-quadrangular, as wide as long, with a shallow lateral depression, without carina; legs with tarsi trimerous; abdomen with six ventrites. The *Nephus* subgenus is characterized by postcoxal line incomplete, extending down from base nearly to apical margin of sternum, and parallel to apical margin toward lateral (Gordon 1985).

Nephus (Nephus) voeltzkowi Weise, 1910 is a mealybug predator known in several countries of sub-Saharan Africa and islands in the Indian Ocean (Fürsch 2007). Parthenogenetic populations of this species have recently been found in the Azores and the Mascarene archipelagos (Magro *et al.* 2020a), which constitutes the first reported case of asexual reproduction in the Coccinellidae. Although there have been some rare introductions of *Nephus* species in America (e.g. Gordon 1985), there is no available record in the literature about any deliberate introduction of *N. voeltzkowi* in the United States of America or anywhere in the Americas. However, we had the opportunity to ask Dr. Paul Skelley, curator of Florida State Collection of Arthropods, Gainesville, FL, for access to type material of *Nephus (Nephus) alyssae* Golia & Golia, 2014, collected from the Florida coastal areas and considered to be a new species, of exotic origin (Golia & Golia 2014). The study of this material together with *N. voeltzkowi* specimens from The Reunion island described in Magro *et al.* (2020b) lead us to establish a junior synonym of *Nephus (Nephus) voeltzkowi* Weise, 1910. Both *Nephus (Nephus) voeltzkowi* and *Nephus (Nephus) alyssae* have the same body shape and size, dorsal and ventral color pattern, each elytron is black with one big oval yellowish elongated spot, reaching the middle of the elytron; the spermatheca with sharp base and truncated apex. For more details and figures, see Golia & Golia 2014 and Magro *et al.* 2020b.

Nephus (Nephus) voeltzkowi Weise, 1910

Nephus (Nephus) voeltzkowi Weise, 1910: 512 (original description); Fürsch 2007: 6 (systematic); Poussereau *et al.* 2018: 128 (systematic); Magro *et al.* 2020b: 130–132 (systematic).

Nephus seychellensis Sicard, 1912: 362 (original description). Synonymized by Chazeau *et al.* 1974: 272.

Scymnus (Nephus) voeltzkowi: Korschevsky 1931: 153 (catalog); Fürsch 1966: 181 (systematic).

Nephus (Nephus) alyssae Golia & Golia, 2014: 1–3 (original description). **Syn. nov.**

The specimens examined are deposited in the following collections: DZUP - Coleção Entomológica Pe. J. S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil (Lúcia M. Almeida); FSCA - Florida State Collection of Arthropods, Gainesville, FL, USA (Paul Skelley).

United States of America: HOLOTYPE (♀), “Florida, Palm Beach/ County, Hypoluxo/ Hypoluxo Scrub N.A./ November 10, 2009/ Vince Golia/ “sweeping”/ 26.566642, - 80.056759”, “Nephus/ sp./ det. R. Gordon 10”, “HOLOTYPE / Nephus/ alyssae/ Golia and Golia” [red label], 1 specimen [FSCA].

Reunion Island: Specimens from a laboratory rearing (Laboratoire Evolution & Diversité Biologique, Université Toulouse III, France) initiated from field material collected in November 2011 in Manapany-les-Bains, 14 specimens [DZUP].

Golia & Golia (2014) in their report of *N. alyssae* (a synonym of *N. voeltzkowi*, as shown in the present work) in Florida mention that males were not captured and base their description exclusively on females (10 individuals), which raises the question of the existence of another possible parthenogenetic population of *N. voeltzkowi* and its colonization of a new continent. An advantage of asexual organisms is their superior colonizing ability, as a single individual can potentially engender a new population. As trade and transport went global, the number of introduced species, namely insects, has considerably increased (Meurisse *et al.* 2019). The fact that *N. voeltzkowi* preys on mealybugs, which are highly common and associated with a large number of plant species, including several important crop plants, might have favoured the ladybird dispersal and settlement in new regions.

Although we cannot exclude more remote sources of colonization, the Azores population of *N. voeltzkowi* is the most likely origin of the colonizing individuals. Colonization of islands from continental sources is a common event but it has also been shown that islands can be an important source of continental diversity (Zhang *et al.* 2017). The Azores relative geographical proximity to the American continent and the fact that it has for centuries acted as one of the crossroads of the North Atlantic Ocean, due to its strategic position, make it a conceivable source of propagules. Furthermore, there is a strong connection between Florida and the Azores because of regular military aircraft exchanges since World War II, and this link has already been pointed as probably at the origin of other species introductions (Martins & Simões 1985, Schaefer *et al.* 2011). The atmospheric conditions could also be involved in this introduction as wind has been identified as playing an important role in dispersal ecology, including in intercontinental oceanic dispersal (De Queiroz 2005). The ability to use thermal uplifts and wind for long range dispersal is common in different insect taxa (Rota *et al.* 2016), and has been mentioned for ladybirds (Siljamo *et al.* 2020). This dispersal mechanism is particularly important for small insects (Wainwright *et al.* 2017), which is the case of *Nephus* spp.

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