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Phytoseiid mites of Rodrigues Island (Acari: Mesostigmata)

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ABSTRACT

Rodrigues is one of the three main islands constituting Mascareignes Archipelago, with La Réunion and Mauritius. It belongs to the state of Mauritius. So far, no mite species of the family Phytoseiidae have been reported from this Island. We report in this paper the results of a survey conducted in November 2018 on Rodrigues Island, during which 18 species have been recorded.

Keywords survey; collection; taxonomy; systematics

Introduction

Mites of the family Phytoseiidae are known for their predatory habits on phytophagous mites and small insects on cultivated plants and wild vegetation. Several of them are used for the control of pest organisms in agricultural open fields and protected crops all around the world (McMurtry and Croft 1997; McMurtry et al. 2013). This family is widespread around the Globe, presents on all continents except Antarctica and consists presently of 2,521 valid species of 94 genera belonging to three sub-families (Demite et al. 2020).

Biodiversity surveys in poorly investigated areas is still an urgent need and might result in the discovery of additional species potentially useful for biological control as well as having more information on the biodiversity of these areas (Kreiter et al. 2020a, b, c).

Most of the Indian Ocean constitutes one of the world’s biodiversity hotspots. The concept of biodiversity hotspot was defined by Myers (1988) in order to identify the most immediately important areas for biodiversity conservation. These hotspots hold high endemism levels and have lost at least 70% of their original natural vegetation (Myers et al. 2000). Knowledge of the phytoseiid diversity in these areas may contribute to future establishment of conservation programs.

Located in the Indian Ocean at 1,740 km from the eastern coast of Madagascar, at 617 km from Mauritius, and 836 km from La Réunion, Rodrigues is one of the three main islands constituting Mascareignes Archipelago, together with La Réunion and Mauritius.

No phytoseiid species have been recorded until now from this island.

The objective of this paper is to present the phytoseiid species recorded as a new survey conducted in November 2018 on Rodrigues Island.

Material and methods

The survey took place on Rodrigues in November 2018. Plant inhabiting mites were collected from cultivated and wild plants in several locations in all parts of the island. Mites were directly collected from leaves with a fine brush or by beating the plants (mainly shrubs and trees). The
mites were collected in a black plastic rectangular saucer 45 x 30 cm (Ref. STR 45, BHR, 71370 Saint-Germain-du-Plain, France). The method selected was depending on the plant investigated: large leaves of shrubs and trees with the direct collection method or by beating, very small leaves or spines of shrubs and trees with the beating method and herbaceous plants with a brush.

Collected mites were then transferred with brush into small plastic vials containing 1.5 ml of 70% ethanol. Mites were then all mounted on slides using Hoyer’s medium and all identified using a phase and interferential contrast microscope (DMLB, Leica Microsystèmes SAS, Nanterre, France). Characters of specimens were measured using a graduated ocular micrometre (Leica, see above).

We have used Chant and McMurtry’s (1994, 2007) concepts of the taxonomy of the family Phytoseiidae for identification and the world catalogue database of Demite et al. (2014, 2020) for distribution. In the description and re-description, the setal nomenclature system adopted was that of Lindquist & Evans (1965) and Lindquist (1994) as adapted by Rowell et al. (1978) for the dorsum and by Chant & Yoshida-Shaul (1991) for the venter. The idiosomal setal pattern follows Chant & Yoshida-Shaul (1992). The notation for solenostomes and poroids is based on Athias-Henriot (1975).

Specimens of each species are deposited in the mite collections of Montpellier SupAgro conserved in UMR CBGP Université de Montpellier INRA/IRD/CIRAD/SupAgro.

Specimens collected in fields in Rodrigues within these surveys were all identified. Only very few single males or immatures collected during this study are not taken into account.

The following abbreviations are used in this paper for institutions: CBGP = Centre de Biologie pour la Gestion des Populations; CIRAD = Centre International de Recherche Agronomique pour le Développement; INRA = Institut National de la Recherche Agronomique; IRD = Institut de Recherche pour le Développement; MSA = Montpellier SupAgro, France; UMR = Unité Mixte de Recherche.

Results and discussion

A total of 18 species have been recorded.

Subfamily Amblyseiinae Muma


Tribe Neoseiulini Chant & McMurtry


Genus Neoseiulus Hughes

Neoseiulus Hughes 1948: 141.

Neoseiulus barkeri Hughes


Typhlodromus (Neoseiulus) barkeri, Nesbitt 1951: 35.

Typhlodromus (Typhlodromus) barkeri, Chant 1959: 63.

Typhlodromus (Amblyseius) barkeri, Hughes 1961: 222.


Amblyseius (Amblyseius) barkeri, van der Merwe 1968: 112.


Amblyseius usitatus van der Merwe 1965: 71 (Synonymy according to Ueckermann & Loots 1988).

Amblyseius oahuensis Prasad 1968: 1518 (Synonymy according to Ragusa & Athias-Henriot 1983).


Amblyseius masiaka Blommers & Chazeau 1974: 308 (Synonymy according to Ueckermann & Loots 1988).

This species belongs to the barkeri species group of the genus Neoseiulus, as the spermathecal atrium is large and forked at junction with major duct. It belongs to the barkeri species subgroup as the calyx is not markedly constricted at junction with the atrium, the atrium is deeply forked at the junction with major duct without vacuolated area, and the major duct, atrium and calyx are of approximately the same width (Chant and McMurtry 2003a).

Various studies had shown its ability to control Frankliniella occidentalis Pergande (Rodriguez-Reina et al. 1992), Thrips tabaci (Lindeman) (Broodsgaard and Stengaard Hansen 1992) and Tetranychus urticae Koch on cucumbers (Fan and Petitt 1994b). Fan and Petitt (1994a) showed that augmentative releases of N. barkeri provided control of broad mite, Polyphagotarsonemus latus (Banks), on peppers. Neoseiulus barkeri constitutes a potential Biological Control Agents (BCA) for several crops especially in vegetable greenhouses. This species had been mentioned by Quilici et al. (2000) and Kreiter et al. (2020c) on La Réunion Island.

World distribution: Neoseiulus barkeri has a worldwide distribution (Moraes et al. 2004; Demite et al. 2020).

Specimens examined: A single ♀ collected during this study. Port-Mathurin, City Center (11 m asl, lat. 19°40′53″ S, long. 63°25′17″ E), 1 ♀ on Litchi chinensis Sonnerat (Sapindaceae), 14/XI/2018.

Remarks: measurements of characters of the female from Rodrigues are only slightly different from female specimens from other countries, especially La Réunion Island. Comparisons with N. barkeri measurements of female and male specimens of various origins in Beaulieu and Beard (2018) show shorter dimensions of all characters of Rodrigues specimens. These authors mentioned shorter dorsal setae of African female and male specimens (lower part of observed ranges) compared to their own measurements (Beaulieu and Beard 2018).

Neoseiulus houstoni Schicha


Neoseiulus recifensis Gondim Jr. & Moraes 2001: 77 (synonymy according to Kreiter et al. 2020c).

Neoseiulus barreti Kreiter in Furtado et al. 2005: 135 (synonymy according to Kreiter et al. 2020c).

This species belongs to the cucumeris species group of Neoseiulus. It was collected and described in 1987 on Vigna unguiculata (L.) Walp. in Queensland, Australia (Schicha 1987) and described long time after under two different species names, N. recifensis Gondim Jr and Moraes and N. barreti Kreiter. Kreiter et al. (2020c) had established those two species as junior synonyms of N. houstoni and described for the first time the male of N. houstoni.
Biology of this species remains totally unknown.

**World distribution:** Australia, Brazil, Reunion Island.

**Specimens examined:** 15 ♀♀ + 1 ♂ in total. **Port-Mathurin,** City Center (11 m aasl, lat. 19°40′53″ S, long. 63°25′17″ E), 1 ♀ on *Citrus limon* (L.) Burman (Rutaceae), 1 ♀ on *Ziziphus mauritiana* Lamark (Rhamnaceae) and 5 ♀♀ and 1 ♂ on *Casuarina equisetifolia* L. (Casuarinaceae), 8/XI/2018 and 1 ♀ on *Ocimum americanum* L. (Lamiaceae), 13/XI/2018; **Port Sud-Est,** Sea Front (2 m aasl, lat. 19°44′36″ S, long. 63°25′17″ E), 3 ♀♀ on *Solanum melongena* L. (Solanaceae) and 3 ♀♀ on *Cordia myxa* L. (Boraginaceae), 11/XI/2018; **Samy** (201 m aasl, lat. 19°42′28″ S, long. 63°24′24″ E), 1 ♀ on *Citrus limon* (L.) Burman (Rutaceae), 12/XI/2018.

**Remarks:** morphological and morphometric characters and all measurements fit well with measurements in Kreiter et al. 2020c. This species was described from Australia, but presented also in Brazil and was firstly mentioned in the Indian Ocean from La Réunion Island, an Island distant of 836 km from Rodrigues. Several species are shared by the two Islands and probably by many others.

**Neoseiulus longispinosus** (Evans)


*Typhlodromus* (*Amblyseius*) *longispinosus,* Chant 1959: 74.


This species belongs to the *barkeri* species group and the *womersleyi* species subgroup as the calyx is markedly constricted at the junction with the atrium that is deeply forked at the junction with the major duct which with atrium and calyx are not of the same width (Chant and McMurtry 2003a).

This species is distributed in many countries of the world, mainly in tropical areas (Moraes et al. 2000; Mailloux et al. 2010; Kreiter et al. 2013, 2018 a, c; Demite et al. 2020). It was found in low numbers in Guadeloupe, Martinique and La Réunion except for studies on companion plants in citrus orchards (Mailloux et al. 2010; Kreiter et al. 2013, 2018c; Le Bellec et al., unpub. data). This species seems to be more common on weeds with populations of tetranychid mites. *Neoseiulus longispinosus,* a type II phytoseid predatory mite, as is *N. californicus* (McMurtry et al. 2013), had received increasing attention in Asia for the control of different spider mites (of *Eutetranychus,* *Oligonychus,* and *Tetranychus*) since 2010 (Nusartlert et al. 2011). The feeding, development, predation, cannibalism, intra-guild predation and behaviour had thus been extensively studied by several authors (e.g., Luong et al. 2017) for pest control purposes. *Neoseiulus longispinosus* is well-known as a BCA sell in several countries in the world for the management of spider mites. The recent results of Huyen et al. (2017) showed at least in controlled laboratory conditions, *N. longispinosus* is a potential biological control agent against the citrus red mite, *Panonychus citri* (McGregor).

**World distribution:** This species is distributed in many countries of the world, mainly in tropical areas.

**Specimens examined:** 17 ♀♀ + 2 ♂ in total. **Baie aux huitres** (8 m aasl, lat. 19°41′40″ S, long. 63°24′30″ E), 3 ♀♀ on *Solanum nigrum* L. (Solanaceae) and 1 ♂ on *Nerium oleander* L. (Apocynaceae), 9/XI/2018; **Anse aux Anglais** (2 m aasl, lat. 19°40′33″ S, long. 63°26′05″ E), 5 ♀♀ and 1 ♂ on *Lagenaria siceraria* (Molina) Standley (Cucurbitaceae), 11/XI/2018; **Port Sud-Est,** Sea Front (2 m aasl, lat. 19°44′36″ S, long. 63°25′17″ E), 6 ♀♀ and 1 ♀ on *Solanum melongena* L. (Solanaceae), 11/XI/2018; **Port-Mathurin,** City Center (11 m altitude above sea level = aasl, lat. 19°40′53″ S, long. 63°25′17″ E), 1 ♀ on *Ocimum americanum* L. (Lamiaceae), 13/XI/2018; **Mont Lubin** (346 m aasl, lat. 19°42′21″ S, long. 63°26′40″ E), 1 ♀ on *Malvastrum coromandelianum* (L.) Garcke (Malvaceae), 15/XI/2018.
Remarks: measurements of specimens of Rodrigues females and males overlap with those obtained for populations of various countries, especially for specimens from La Réunion Island (Kreiter et al. 2020c).

Tribe Kampimodromini Kolodochka

Subtribe Paraphytoseiina Chant & McMurtry
Paraphytoseiina Chant & McMurtry 2003b: 211.

Genus Paraphytoseius Swirski & Shechter

Paraphytoseius horrifer (Pritchard & Baker)
Amblyseius (Paraphytoseius) horrifer, van der Merwe 1968: 169.  

In our collected species of Paraphytoseius, setae S5 are absent. Therefore, according to Chant and McMurty (2003b) it belongs to the orientalis species group. Like Chant and McMurtry (2003b), and Moraes et al. (2007), we treated P. horrifer and P. orientalis as two different valid species. Our specimens have relatively longer s4, Z4, Z5, and lack a distinct short, thick, spatulate macroseta on genu I. Consequently, they belong to the former species. This species is widely distributed in Sub-Saharan Africa and Madagascar. The biology of P. horrifer remains totally unknown.

World distribution: Benin, DR Congo, Ghana, India, Kenya, La Réunion Island, Madagascar Island, Malawi, Mozambique, Senegal, South Africa, Uganda.

Specimens examined: 4 ♀♀ in total. Citronelle, city parc (349 m asl, lat. 19°42′00″ S, long. 63°26′15″ E), 3 ♀♀ on Tibouchina heteromalla Cogniaux and 1 ♀ on Cryptomeria japonica D. Don (Taxodiaceae), 16/XI/2020.

Remarks: morphological and morphometric characters and all measurements fit well with measurements in Kreiter et al. 2020b, c. This species was described from Africa (Pritchard & Baker 1962), but distributed also in Vietnam (Kreiter et al. 2020b) and was firstly mentioned in the Indian Ocean from la Réunion Island, an Island distant of 836 km from Rodrigues. Several species are shared by the two Islands and probably by many others.

Tribe Phytoseiulini Chant & McMurtry

Genus Phytoseius Evans
Phytoseius Evans 1952: 397.
Phytoseiulus persimilis Athias-Henriot

Phytoseiulus (Phytoseiulus) persimilis, Wainstein 1962: 17. 
Phytoseiulus longipes Evans 1958: 306 (synonymy according to Denmark et al. 1999). 
Phytoseiulus riegeli Dosse 1958: 48 (synonymy according to Chant 1959). 
Phytoseiulus tardi (Lombardini 1959): 166 (synonymy according to Kennett & Caltagirone 1968).

Phytoseiulus persimilis is a Mediterranean / subtropical predatory mite that is a type I species, i.e., a specialist predator of the urticae species group of the genus Tetranychus (McMurtry and Croft 1997; McMurtry et al. 2013). Considerable research had been conducted on this predator-prey interaction (see review by Kostiainen and Hoy 1996), and numerous biological control programs had used P. persimilis against T. urticae on a wide range of ornamental and vegetable crops. Phytoseiulus persimilis was the first greenhouse biological control agent available commercially and is one of the most successful biological control agents. It can also be used in temperate climates on open-field crops such as strawberries. Optimum conditions are 20-27 °C and relative humidity of 60-90%. Cooler or warmer temperatures may have a negative effect on reproduction, development and efficiency of this predatory mite. This species is present on Rodrigues probably because of its commercial introduction and uses in vegetable and ornamental greenhouses, dispersion of some specimens released and establishment in the environment. This species was reared and sold on La Réunion and commercialized in Mascareignes since a long time (Quilici, personal communication).

World distribution: widely distributed in Africa, Australia, Europe, especially Mediterranean countries, South America, and Asia, probably after largely distributed commercial uses in the world, dispersion in the environment in at least some locations and establishments of this species.

Specimens examined: 2 ♀♀ in total. Port Sud-Est, Sea Front (2 m asl, lat. 19°44′36″ S, long. 63°25′17″ E), 2 ♀♀ on Solanum melongena L. (Solanaceae), 11/XI/2018.

Remarks: measurements of adult females collected in this work agree very well with measurements in the literature, especially those of Ueckermann et al. (2007).

Macrosetae on basitarsus of leg IV are not serrated, but macrosetae of genu and tibia are serrated and there is no pre-anal macrosetae on the ventrianal shield. These are key characters of P. persimilis in comparison with the closely related species Phytoseiulus macropilis (Banks) (Okassa et al. 2010).

Tribe Amblyseiini Muma


Subtribe Amblyseiina Muma


Genus Amblyseius Berlese

Amblyseius Berlese 1914: 143.

Amblyseius herbicolus (Chant)

Typhlodromus (Amblyseius) herbicolus Chant 1959: 84. 
Amblyseius impactus Chaudhri 1968: 553 (synonymy according to Daneshvar & Denmark 1982; Denmark & Muma 1989). 
Typhlodromus (Amblyseius) amitae Bhattacharyya 1968: 677 (synonymy according to Denmark & Muma 1989). 
Amblyseius deleoni Muma & Denmark 1970: 68 (synonymy according to Daneshvar & Denmark 1982; Denmark & Muma 1989). 
Amblyseius (Amblyseialus) thermophilus Karg 1991: 12 (synonymy according to El-Banhawy & Knapp 2011; Demite et al. 2020).

This species belongs to the largoensis species group as setae J2 and Z1 are present, setae s4 are minute and the ventrialial shield of the female is vase-shaped. It belongs to the largoensis species subgroup as setae Z4 are long, spermatheca has the calyx elongate and the female ventrialial shield is entire (Chant and McMurtry 2004).

It is widespread in all tropical and subtropical regions of the world. It is the second most abundant phytoseiid mite on Coffea arabica L. in Brazil, associated with Brevipalpus phoenicis (Geijskes), vector of the coffee berry borer and it was found to be an efficient predator (Reis et al. 2007). Amblyseius herbicolus is also found associated with the broad mite, P. latus in crops such as chili pepper (Capsicum annuum L.) in Brazil and has also a good potential for controlling the pest. Rodriguez-Cruz et al. (2013) had studied biological, reproductive and life table parameters of A. herbicolus on three different diets: broad mites, castor bean pollen (Ricinus communis L.) and sun hemp pollen (Crotalaria juncea L.). The predator was able to develop and reproduce on all these three diets. However, its intrinsic growth rate was higher on broad mites and castor bean pollen. Feeding on alternative food such as pollen can facilitate the predator’s mass rearing and maintain its population on crops when prey is absent or scarce. Many polyphagous generalist phytoseiid mites are important natural enemies because they can feed on plant provided pollen and various prey species, and thus persist in crops even in the absence of target pests (McMurtry et al. 2013). Hence, populations of these predators can be established in a crop by providing alternative food, thus increasing biological control. Alternative food affects P. latus control on chilli pepper plants by predatory mites (Duarte et al. 2015). Amblyseius herbicolus had high oviposition and population growth rates when fed with cattail pollen (Typha latifolia L.), chilli pepper pollen and bee-collected pollen, and a low rate on the alternative prey T. urticae. Supplementing pepper plants with pollen resulted in better control of broad mite populations (Duarte et al. 2015). Release of A. herbicolus on young plants with weekly addition of honeybee pollen or cattail pollen until plants produce flowers seems a viable strategy to sustain populations of this predator (Duarte et al. 2015). Amblyseius herbicolus was recorded recently in Comoros archipelago (Kreiter et al. 2018b) and in La Réunion (Quilici et al. 1997, 2000; Kreiter et al. 2020c).

World distribution: Argentina, Australia, Azores, Benin, Brazil, Burundi, Canary Islands, China, Colombia, Comore Island, Costa Rica, Dominican Republic, Dr Congo, El Salvador, Ghana, Guadeloupe Island, Guatemala, Hawaii, Honduras, India, Iran, Kenya, Les Saintes Island, La Réunion Island, Madagascar Island, Malawi, Malaysia, Martinique Island, New Caledonia Island, Papua New Guinea, Peru, Philippines, Portugal, Puerto Rico, Rwanda, Senegal, Singapore, South Africa, Spain, Taiwan, Thailand, Turkey, USA, Venezuela, West Indies.

Specimens examined: a single ♀ during this study. Mont Lubin (346 m aasl, lat. 19°42′21″ S, long. 63°26′40″ E), 1 ♀ on Passiflora edulis Sims (Passifloraceae), 15/XI/2018.

Remarks: morphological and morphometric characters and all measurements fit well with measurement values given by Kreiter et al. (2018b, 2020c) for specimens from Grande Comore in Comoros and from La Réunion and by Ferragut and Baumann (2019) for specimens from Mauritius.
**Amblyseius largoensis (Muma)**

*Amblyseiopsis largoensis* Muma 1955: 266.  
*Amblyseius magnolia* Muma 1961: 289 (Synonymy according to Denmark & Evans 2011).  
*Amblyseius sakalava* Blommers 1976: 96 (Synonymy according to Ueckermann & Loots 1988).  
*Amblyseius amtalaensis* Gupta 1977: 53 (Synonymy according to Gupta 1986).

This species belongs to the *largoensis* species group, and the *largoensis* species subgroup for the same reasons.

It is widespread in all tropical and subtropical regions of the world and was the most abundant species collected by Moraes et al. (2000) in French Caribbean Islands.

Using morphometric analyses of 36 characters, molecular analyses and crossing tests, Navia et al. (2014) studied specimens collected from Brazil, La Réunion Island and Trinidad and Tobago to determine whether *A. largoensis* populations from different geographic origins belong to the same taxonomic entity. Though differences in the lengths of some setae were observed, molecular analyses and crossing experiments indicated that populations from Indian Ocean and America were conspecific.

**World distribution:** this species is widely distributed in the tropical and subtropical regions of Africa, America, Asia and the Pacific Islands.

**Specimens examined:** 40 ♀♀ + 6 ♂♂ in total. **Port-Mathurin,** City Center (10 m aasl, lat. 19°40′53″ S, long. 63°25′17″ E), 5 ♀♀ on *Citrus limon* (L.) Burman (Rutaceae), 8/XI/2018 and 1 ♂ + 1 ♀ on *Litchi chinensis* Sonnerat, 14/XI/2018; **Accacia** (11 m aasl, lat. 19°40′48″ S, long. 63°25′07″ E), 1 ♀ on *Mangifera indica* L. (Anacardicaceae), 9/XI/2018; Baie aux Huitres (8 m aasl, lat. 19°41′16″ S, long. 63°24′13″ E), 1 ♀ on *Carica papaya* L. (Caricaceae) and 2 ♀♀ on *Polyscias scutellaria* (Burman) Fosberg (Araliaceae), 9/XI/2018; **Quatre-Vents** (293 m aasl, lat. 19°44′12″ S, long. 63°27′19″ E), 2 ♀♀ on *Mimusops coriacea* (de Candolle) Miqel (Sapotaceae), 3 ♀♀ on *Pandanus heterocarpus* Balfour (Pandanaeaceae), 12/XI/2018; **Sanny** (201 m aasl, lat. 19°42′28″ S, long. 63°24′24″ E), 3 ♀♀ and 3 ♂♂ on *Citrus limon* (L.) Burman (Rutaceae), 12/XI/2018; **Allée Tamarin** (71 m aasl, lat. 19°41′22″ S, long. 63°24′11″ E), 4 ♀♀ on *Pittosporum balfouri* Cufodontis (Pittosporaceae), 12/XI/2018; **Baie aux huitres,** Front Sea (8 m aasl, lat. 19°41′40″ S, long. 63°24′30″ E), 1 ♀ on *Cupressus sempervirens* L. (Cupressaceae), 9/XI/2018; **Petite-Butte** (80 m aasl, lat. 19°45′00″ S, long. 63°23′00″ E), 3 ♀♀ on *Ixora* sp. (Rubiaceae) and 1 ♀ and 1 ♂ on *Tarrenna borbonica* (E.G. Henderson et A.A. Henderson) Verdcourt (Rubiaceae), 14/XI/2018; **Mont Lubin** (346 m aasl, lat. 19°42′21″ S, long. 63°26′40″ E), 1 ♀ on *Litsea glutinosa* (Loureiro) Robinson (Lauraceae), 15/XI/2018; **Citronelle**, city parc (349 m aasl, lat. 19°42′00″ S, long. 63°26′15″ E), 8 ♀♀ on *Cryptomeria japonica* D. Don (Taxodiaceae) and 3 ♀♀ and 1 ♂ on *Mimusops coriacea* de Candolle (Miqel), 16/XI/2020; **Citronelle,** Plant Protection Service (388 m aasl, lat. 19°42′02″ S, long. 63°25′17″ E), 1 ♀ on *Punica persica* (L.) Batsch (Rosaceae), 16/XI/2020.

**Remarks:** morphological and morphometric characters and all measurements fit well with measurement values given by Zannou et al. (2007) for specimens from Africa, Navia et al. (2014) for specimens from Brazil, La Réunion and Trinidad and Tobago and Ferragut and Baumann (2019) for specimens from Mauritius. This is of the three more numerous species collected during this study and probably one of the more common species on the island, with *A. passiflorae* and *E. ovaloides.*
**Amblyseius passiflorae** Blommers


This species belongs to the *largoensis* species group, and the *arcus* species subgroup as the spermatheca is dish-, cup- or bell-shaped and to the *vasiformis* species complex as seta Z5 is very long. Its biology is totally unknown.

This species was only known from the type series (five females and one male) (Blommers 1974). The original description was rather complete, providing comprehensive information on female and male morphology, and Ferragut and Baumann (2019) had added information on dorsal adenotaxy and poroidotaxy. This species was collected for the latter authors and thus already recorded from Mauritius, but of course not from Rodrigues.

**World distribution**: Madagascar, Mauritius.

**Specimens examined**: 50 ♀♀ and 15 ♂♂ in total. **Quatre-Vents** (293 m aasl, lat. 19°44′12″ S, long. 63°27′19″ E), 8 ♀♀ and 9 ♂♂ on *Mangifera indica* L. (Anacardiaceae), 1 ♂ on *Cordia dichotoma* Forster (Boraginaceae) and 1 ♀ and 1 ♂ on *Hibiscus rosa-sinensis* L. (Malvaceae), 12/XI/2018; **Sany** (201 m aasl, lat. 19°42′28″ S, long. 63°24′24″ E), 1 ♀ on *Citrus limon* L. Burman (Rutaceae), 12/XI/2018; **Mont Lubin** (346 m aasl, lat. 19°42′21″ S, long. 63°26′40″ E), 8 ♀♀ and 1 ♂ on *Clematis mauritiana* Lamarck (Ranunculaceae), 10 ♀♀ and 1 ♂ on *Litsea glutinosa* (Loureiro) Robinson (Lauraceae), 3 ♀♀ on *Litsea boryanus* de Candolle (Malvaceae), 1 ♀ on *Urena lobata* L. (Malvaceae), 1 ♀ on *Rubus rosifolius* Smith (Rosaceae), 9 ♀♀ and 3 ♂♂ on *Litsea monopetala* (Roxburgh) Person (Lauraceae), 1 ♀ on *Syngonium podophyllum* Schott (Araceae) and 2 ♀♀ on *Terminalia arjuna* (Roxburgh) Wight et Arnott (Combretaceae), 15/XI/2018.

**Remarks**: this species was reported before by Ferragut and Baumann (2019). Morphological and morphometric characters and all measurements of our specimens fit well with measurements in Blommers (1974) and Ferragut and Baumann (2019). This is one of the three more numerous species collected during this study and probably one of the more common species in the island, together with *A. largoensis* and *Euseius ovaloides*.

**Amblyseius tamaatavensis** Blommers


This species belongs to the *obtusus* species group as setae J2 and Z1 are present, setae Z4 are minute and the female ventrianal shield is not vase-shaped or divided. It belongs to the *aerialis* species subgroup (46 species) as the calyx of the spermatheca is tubular (Chant and McMurtry 2004).

It seems to fit the functional type III-b (generalist predators living on glabrous leaves) group defined by McMurtry *et al.* (2013). Cavalcante *et al.* (2017) reported this species as a promising natural enemy of *B. tabaci*. Experimental releases of this predator on caged plants in a greenhouse caused the reduction of the density of *B. tabaci* on pepper plants by up to 60-80% (Massaro and Moraes 2019). It can be easily produced in large numbers (Massaro *et al.* 2018) when fed with astigmatine mites, which could allow the mass production for augmentative biological control. This species is reported from tropical areas from over 20 countries around the world (Africa, Asia, America and Oceania). It was recorded in La Réunion (Quilici *et al.* 2000).

**World distribution**: this species was described from Madagascar, but is actually widely distributed in several countries of tropical and subtropical regions of Africa, America, Asia and the Pacific Islands.
Specimens examined: 5 ♀♀ in total. Graviers (5 m aasl, lat. 19°43′37″ S, long. 63°28′50″ E), 5 ♀♀ on Capsicum annuum L. (Solanaceae), 16/XI/2020.

Remarks: this species was described from Madagascar (Blommers 1974), then mentioned in the Indian Ocean from La Réunion Island (Quilici et al. 2000) and recently from Mauritius (Ferragut and Baumann 2019). Morphological and morphometric characters and all measurements of our specimens fit well with measurements in Blommers (1974), Ferragut and Baumann (2019) and Kreiter et al. (2020c).

Subtribe Proprioseiopsina Chant & McMurtry


Genus Proprioseiopsis Muma


Proprioseiopsis mexicanus (Garman)

Amblyseioidea mexicanus Garman 1958: 75.
Proprioseiopsis tropicalis (Garman 1958): 77 (Synonymy according to Denmark & Evans 2011).
Proprioseiopsis asetus (Chant 1959): 80 (Synonymy according to Denmark & Evans 2011).
Proprioseiopsis putmani (Chant 1959): 91 (Synonymy according to Denmark & Evans 2011).
Proprioseiopsis clausae (Muma 1962): 20 (Synonymy according to Denmark & Evans 2011).
Proprioseiopsis temperellus (Denmark & Muma 1967): 171 (Synonymy according to Denmark & Evans 2011).
Proprioseiopsis amotus (Zack 1969): 72 (Synonymy according to Denmark & Evans 2011).
Proprioseiopsis versutus (Zack 1969): 74 (Synonymy according to Denmark & Evans 2011).
Proprioseiopsis kogi (Chant & Hansell 1971): 713 (Synonymy according to Denmark & Evans 2011).
Proprioseiopsis tulearensis (Blommers 1976): 100 (Synonymy according to Denmark & Evans 2011).

This species belongs to the belizensis species group as genu I have no macrosetae. As the spermatheca of that species has a short calyx, cup-shaped, it belongs to the asetus species subgroup (Chant and McMurtry 2005a).

This species is known from all Islands of French West Indies (Kreiter and Moraes 1997; Moraes et al. 2000; Kreiter et al. 2006, 2018c; Mailloux et al. 2010), but it was found only in very large numbers during a previous study on companion plants in Guadeloupe (Mailloux et al. 2010) and in a study on La Réunion (Le Bellec, unpub. data). This species seems to be very abundant on weeds in the lower vegetation. Phytoseiid mites of the genus Proprioseiopsis had been found mainly in ground surface, humus, litter, soil, moss or on grass (Muma and Denmark 1970; McMurtry et al. 2015).

Proprioseiopsis mexicanus population increased when fed T. urticae eggs (Megevand et al. 1993) and seems to be a good predator of thrips (Kreiter, unpub. data). It is one of the prevailing phytoseiid species on citrus orchards in Alabama (Fadamiro et al. 2009). Denmark and Evans (2011) mentioned that the species can be reared on T. urticae and Oligonychus pratensis (Banks) and is associated with Bryobia praeliosa Koch, Bryobia spp. and P. ulmi. It was also found in association with Tetranychus evansi Baker and Pritchard (Furtado et al. 2014), but mentioned as a poor predator of that species. The biology of this species is however almost unknown.
Proprioseiopsis mexicanus was already recorded in the Indian Ocean by Quilici et al. (2000) and Kreiter et al. (2020c).

**World distribution:** This species is distributed in many countries of the world, mainly in tropical areas.

**Specimens examined:** 2 ♀♀ in total. *Citronelle*, Plant Protection Service (388 m asl, lat. 19°42′02″ S, long. 63°25′17″ E), 2 ♀♀ on *Prunus persica* (L.) Batsch (Rosaceae), 16/XI/2020.

**Remarks:** measurement values of female specimens from Rodrigues fit well with all those indicated in Kreiter et al. (2018c, 2020c) for various countries.

### Tribe Euseiini Chant & McMurtry


### Subtribe Euseilina Chant & McMurtry


### Genus *Euseius* Wainstein

*Amblyseius* (*Amblyseius*) section *Euseius* Wainstein 1962: 15; *Euseius* De Leon 1966: 86.

**Euseius ovaloides** (Blommers)


*Euseius ovaloides* was described by Blommers (1974) from specimens collected on *Citrus hystrix* and *Persea americana* in Madagascar. Like all *Euseius* species, this species belongs to the type IV (polliniphagous generalist predators) of McMurtry and Croft (1997) and McMurtry et al. (2013). The species had been occasionally recorded in Madagascar (Blommers 1974), Papua-New Guinea (Schicha and Gutierrez 1985), Seychelles (Schicha 1987), La Réunion Island (Quilici et al. 1997, 2000), Guadeloupe, Martinique and Marie-Galante (Moraes et al. 2000; Kreiter et al. 2006) on various plants, though its biology remains unknown. It is suspected to be a poor predator of tetranychid mites (Gutierrez and Etienne 1986), but can be considered as a potentially good predator of thrips and whiteflies. This is one of the most common species on La Réunion Island.

**World distribution:** Guadeloupe, Madagascar Island, Marie-Galante, Martinique, Papua New Guinea, La Réunion Island, Seychelles Archipelago, Vietnam.

**Specimens examined:** 102 ♀♀, 13 ♂♂ and 3 im. in total. *Port-Mathurin*, City Center (11 m aasl, lat. 19°40′53″ S, long. 63°25′17″ E), 10 ♀♀ and 1 ♂ on *Terminalia catappa* L. (Combretaceae), 12 ♀♀ on *Ricinus communis* L. (Euphorbiaceae), 1 ♀ on *Artocarpus altlis* (Parkinson) Fosberg (Moraceae), 2 im. on *Allamanda cathartica* L. (Apocynaceae), 8/XI/2020; 1 ♀ on *Ziziphus mauritiana* Lamarck (Rhamnaceae), 2 ♀♀ and 1 ♂ on *Codiaeum variegatum* (L.) Jussieu (Euphorbiaceae); 3 ♀♀ and 1 ♂ on *Acalypha wilkesiana* Müller Argoviensis (Euphorbiaceae), 9/XI/2018; 1 ♀ on *Polyscias scutellaria* (Burman) Fosberg (Araliaceae), 11 ♀♀ and 2 ♂♂ on *Bougainvillea* sp. (Nyctaginaceae) and 10 ♀♀ on *Duranta erecta* L. (Verbenaceae), 11/X/2018; 1 ♀ and 2 ♂♂ on *Litchi chinensis* Sonnerat (Sapindaceae), 14/X/2018; *Baie aux huitres*, Front Sea (8 m aasl, lat. 19°41′40″ S, long. 63°24′30″ E), 2 ♀♀ and 1 im. on *Carica papaya* L. (Caricaceae), 5 ♀♀ and 1 ♂ on *P. scutellaria*, 3 ♀♀ on *Morinda citrifolia* L. (Rubaceae), 9/X/2018; *Anse aux Anglais* (2 m aasl, lat. 19°40′33″ S, long. 63°26′05″ E), 2 ♀♀ on *Tamarindus indica* L. and 4 ♀♀ and 2 ♂♂ on *Ceasalpinia pulcherrima* (L.) Swartz (Caesalpiniaceae), 11/X/2018; *Port Sud-Est*, Sea Front (2 m aasl, lat. 19°44′36″ S, long. 63°25′17″ E), 13 ♀♀ on *R. communis*, 11/X/2018; *Allée Tamarin* (71
m aasl, lat. 19°41′22″ S, long. 63°24′11″ E), 6 ♀♀ and 2 ♂♂ on R. communis and 4 ♀♀ on C. papaya, 12/XI/2018; Plaine-Caverne (45 m aasl, lat. 19°41′02″ S, long. 63°25′11″ E), 1 ♀ on C. papaya, 14/XI/2018; Petite-Butte (80 m aasl, lat. 19°45′06″ S, long. 63°23′08″ E), 1 ♂ on Ixora sp. (Rubiaceae), 14/XI/2018; Mont Lubin (346 m aasl, lat. 19°42′21″ S, long. 63°26′40″ E), 1♀ on Hibiscus boryanus de Candolle (Malvaceae), 2 ♀♀ on R. communis and 6 ♀♀ on Terminalia arjuna (Roxburgh) Wight et Arnott (Combretaceae), 15/XI/2018; Graviers (5 m aasl, lat. 19°43′37″ S, long. 63°28′59″ E), 1♀ on Passiflora edulis Sims (Passifloraceae), 16/XI/2020.

**Remarks:** this species was reported from several countries of the world especially from Madagascar, Seychelles Archipelago and La Réunion Island (Quilici *et al.* 2000; Kreiter *et al.* 2020c). This species has recently been reported from Vietnam (Kreiter *et al.* 2020b). Morphological and morphometric characters and all measurements of our specimens fit well with measurements in Kreiter *et al.* (2020b). This is the most numerous species collected during this study and just like La Réunion, probably one of the most common species in the Island, with A. largoensis and A. passiflorae.

**Subfamily Phytoseiinae Berlese**

Phytoseiini Berlese 1913: 3; Phytoseiinae Vitzthum 1941: 767.

**Genus Phytoseius Ribaga**

*Phytoseius* Ribaga 1904: 177

**Phytoseius coheni** Swirski & Shechter

*Phytoseius* (Dubininellus) macropilis coheni Swirski & Shechter 1961: 104.
*Phytoseius* hawaiiensis Prasad 1968: 1460 (synonymy according to Denmark & Evans 2011).
*Phytoseius* huangi Ehrara 1970: 62 (synonymy according to Ehrara 2002).
*Phytoseius* jianfengensis Chen, Chu & Zhou 1980: 15 (synonymy according to Wu 1997).

This species belongs to the horridus species group as setae J2 and R1 are absent (Chant and McMurtry 1994).

This species was described from Hong-Kong by Swirski and Shechter (1961) collected on a wide range of plants and very common on citrus. Although species of the genus *Phytoseius* are considered to belong to the type III (polyphagous generalist predators) of McMurtry and Croft (1997) and McMurtry *et al.* (2013), its specific biology is totally unknown.

**World distribution:** Australia, China, Hawaii, Hon-Kong, India, Indonesia, Japan, Malaysia, Mauritius, Papua New Guinea, Philippines, Singapore, Tahiti, Taiwan, Thailand, USA.

**Specimens examined:** a single ♀ during this study. Port-Mathurin, City Center (11 m aasl, lat. 19°40′53″ S, long. 63°25′17″ E), 1 ♀ on Polyscias scutellaria (Burman) Fosberg (Araliaceae), 11/XI/2020.

**Remarks:** this species was firstly reported from Mauritius by Schicha (1984) under the junior synonym name *P. hawaiiensis*. Ferragut and Baumann (2019) recovered the species. Kreiter *et al.* (2020b) have recently reported this species from Vietnam. Morphological and morphometric characters and all measurements of our specimens fit well with measurements in Kreiter *et al.* (2020b).
Phytoseius crinitus Swirski & Shechter


This species belongs to the horridus species group (Chant and McMurtry 1994). This species was recorded in several countries of Asia, in Burundi, Madagascar (Demite et al. 2020) and La Réunion (Quilici et al. 2000; Demite et al. 2020). The biology of this species remains totally unknown.

**World distribution:** Burundi, China, Hong Kong, India, Indonesia, Japan, Madagascar Island, Philippines, La Réunion Island, Singapore, Taiwan.

**Specimens examined:** 2 ♀♀ in total. **Quatre-Vents** (293 m aasl, lat. 19°44′12″ S, long. 63°27′19″ E), 1 ♀ on Pandanus heterocarpus Balfour (Pandanaceae), 12/XI/2018; **Port-Mathurin,** City Center (11 m aasl, lat. 19°40′53″ S, long. 63°25′17″ E), 1 ♀ on Ocimum americanum L. (Lamiaceae), 13/XI/2018.

**Remarks:** this species was reported before by Ferragut and Baumann (2019) from Mauritius, but it was already reported by Quilici et al. (2000) from Mascareignes Archipelago in La Réunion Island where Kreiter et al. (2020c) have recently recovered the species. Morphological and morphometric characters and all measurements of our specimens fit well with measurements in Kreiter et al. (2020c).

Phytoseius haroldi Ueckermann & Kreiter


This species belongs to the horridus species group as setae J2 and R1 are absent (Chant and McMurtry 1994). It was abundant on lower vegetation in a study of companion plants in citrus orchard in La Réunion Island (Kreiter et al. 2020c). It seems that this species prefers low plants, but despite this observation that has to be confirmed, the biology of this species remains totally unknown.

**World distribution:** La Réunion Island, Mauritius Island.

**Specimens examined:** 2 ♀♀ in total. **Port-Mathurin,** City Center (11 m aasl, lat. 19°40′53″ S, long. 63°25′17″ E), 1 ♀ on Ziziphus mauritiana Lamarck (Rhamnaceae), 9/XI/2020; **Port Sud-Est,** Sea Front (2 m aasl, lat. 19°44′36″ S, long. 63°25′17″ E), 1 ♀ on Solanum melongena L. (Solanaceae), 11/XI/2018.

**Remarks:** this species was described by Ueckermann and Kreiter in Kreiter et al. (2002) from La Réunion Island and then reported from Mauritius by Ferragut and Baumann (2019). Morphological and morphometric characters and all measurements of our specimens fit well with measurements of the original description by Kreiter et al. (2002) concerning specimens from La Réunion Island, Ferragut and Baumann (2019) for specimens from Mauritius and Kreiter et al. (2020c) for additional specimens from La Réunion Island.

Phytoseius intermedius Evans & Macfarlane


This species belongs to the horridus species group as setae J2 and R1 are absent (Chant and McMurtry 1994). It was recorded in several countries of Asia, Africa, Madagascar (Demite et al. 2020) and was known from La Réunion (Quilici et al. 2000; Demite et al. 2020).
The biology of this species remains totally unknown. This is the most numerous species of Phytoseius in this study.

Specimens examined: 13 ♀♀ in total. Port-Mathurin, City Center (11 m aasl, lat. 19°40′53″ S, long. 63°25′17″ E), 1 ♀ on Cordia dichotoma Forster (Boraginaceae), 3 ♀♀ on Ziziphus mauritiana L. (Rhamnaceae), 8/XI/2018; Anse aux Anglais (2 m aasl, lat. 19°40′33″ S, long. 63°26′05″ E), 6 ♀♀ on C. dichotoma, 11/XI/2018; Port Sud-Est, Sea Front (2 m aasl, lat. 19°44′36″ S, long. 63°25′17″ E), 3 ♀♀ on Cordia myxa L. (Boraginaceae), 11/XI/2018.

Remarks: measurement values of morphological characters of specimens from Rodrigues and specimens from neighbouring countries are very close, especially for specimens from La Réunion (Kreiter et al. 2020c).

Subfamily Typhlodrominae Wainstein


Genus Typhlodromus Scheuten

Typhlodromus Scheuten, 1857: 111

Subgenus Anthoseius De Leon


Typhlodromus (Anthoseius) lobatus Zannou, Moraes & Oliveira

Typhlodromus (Anthoseius) lobatus Zannou, Moraes & Oliveira in Ueckermann et al. 2008: 59.

This species belongs to the large rhenanus species group (Chant and McMurtry 1994). The biology of that species is totally unknown.

World distribution: Ghana.

Specimens examined: 13 ♀♀ and 1 ♂ in total. Mont Lubin (346 m aasl, lat. 19°42′21″ S, long. 63°26′40″ E), 1 ♀ on Psidium guajava L. (Myrtaceae), 2 ♀♀ on Vitex trifolia L. (Lamiaceae), 8 ♀♀ and 1 ♂ on Urena lobata L. (Malvaceae) and 2 ♀♀ on Litsea monopetala (Roxburgh) Person (Lauraceae), 15/XI/2018.

Remarks: morphological and morphometric characters and all measurements of our specimens fit well with measurements of the original description by Zannou, Moraes and Oliveira in Ueckermann et al. (2008) concerning specimens from Ghana, Western Africa.

Typhlodromus (Anthoseius) muliebris van der Merwe


Amblydromella muliebris, Moraes et al. 1986: 168.

Amblydromella (Amblydromella) muliebris, Denmark & Welbourn 2002: 308.

This species belongs to the large rhenanus species group (Chant and McMurtry 1994). It was described by van der Merwe (1968) from South Africa and then reported by El-Banhawy and Knapp (2011) from Kenya. The biology of that species is totally unknown. This is the first report of that species from a country outside the Africa continent.

World distribution: Kenya, South Africa.

Specimens examined: a single ♀ during this study. Port-Mathurin, City Center (11 m aasl, lat. 19°40′53″ S, long. 63°25′17″ E), 1 ♀ on Pandanus heterocarpus Balfour (Pandanaceae), 8/XI/2020.
Remarks: morphological and morphometric characters and all measurements of our specimens fit well with measurements of the original description by van der Merwe (1968) and redescriptions by Ueckermann et al. (2008) and El-Banhawy and Knapp (2011) concerning specimens from South Africa and Kenya, respectively.

**Typhlodromus (Anthoseius) moraesii** Kreiter & Ueckermann


The biology of this species found in La Réunion Island by Kreiter et al. (2002) on various host plants and then in French Caribbean Islands (Mailloux et al. 2010; Kreiter et al. 2013) remains unknown.

**World distribution:** Guadeloupe, La Réunion Island.

**Specimens examined:** 4 ♀♀ in total. **Port-Mathurin,** City Center (11 m aasl, lat. 19°40’ 53” S, long. 63°25’ 17” E), 1 ♀ on *Miscanthus sinensis* Andersson (Poaceae), 8/XI/2018; **Samy** (201 m aasl, lat. 19°42’ 28” S, long. 63°24’ 14” E), 1 ♀ on *Citrus limon* (L.) Burman (Rutaceae), 12/XI/2018; **Allee Tamarin** (71 m aasl, lat. 19°41’ 22” S, long. 63°24’ 11” E), 2 ♀ on *Pittosporum balfouri* Cufodontis (Pittosporaceae), 12/XI/2018.

**Remarks:** several species are found both on La Réunion Island (in the Indian Ocean) and in the West Indies, probably because of reciprocal introductions certainly long time ago with slave markets and commercial exchanges between the two areas or because of introduction of plants in Antilles and La Réunion coming from the same African area than slaves. The measurements and description of the specimens collected fit very well with those given by Kreiter et al. (2002).

**Conclusion**

The results of an additional survey made in 2018 on Rodrigues Island is presented in this paper. A total of 18 records, 11 Amblyseiinae, 4 Phytoseiinae and 3 Typhlodrominae, have been obtained. The fauna of Rodrigues after our study is composed of this 18 species, namely: *Neoseiulus barkeri, N. houstoni, N. longispinosus, Paraphytoseius hornirfer, Phytoseiulus persimilis, Ambyseius herbicola, A. largoensis, A. passiflorae, A. tamatavensis, Proprioseiopsis mexicanus, Euseius ovaloideus, Phytoseius coheni, P. crinitus, P. haroldi, P. intermedius, Typhlodromus (Anthoseius) lobatus, T. (A.) muliebris* and *T. (A.) moraesii.*

Among the 18 recorded species, at least seven species are known as biological control agents (BCA). In addition to the intrinsic value of phytoseid mite biodiversity in tropical environments, demonstration of the natural occurrence of efficient BCAs in a developing country such as Rodrigues is of great agricultural, commercial and strategic interests for the country.

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