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Phytoseiid mites (Acari: Mesostigmata) of Anjouan Island (Comoros Archipelago)

Serge Kreiter \textsuperscript{a}, Rose-My Payet \textsuperscript{b}, Hamza Abdou Azali \textsuperscript{c}

\textsuperscript{a} CBGP, Institut Agro (SupAgro), INRAE, CIRAD, IRD, Univ Montpellier, Montpellier, France.
\textsuperscript{b} CIRAD, Université de Montpellier, Unité Hortsys, Station de Bassin-Plat, 97410 Saint-Pierre, La Réunion, France.
\textsuperscript{c} INRAPE, Moroni, Grande Comore, Union des Comores.

Original research

ABSTRACT

Anjouan is one of the four main islands constituting Comoros Archipelago, with Mayotte, Mohéli and Grande Comore Islands. It is the second Island closer from Madagascar after Mayotte. So far, no species of the mite family Phytoseiidae (Acari: Mesostigmata) had been reported from this island. In this paper, 18 species are recorded from a survey conducted at the end of 2018 in Anjouan Island.

Keywords survey; collection; taxonomy; systematics

Introduction

Mites of the family Phytoseiidae are all predatory species on phytophagous mites and small insects such as thrips and whiteflies, on commercial plants and the wild vegetation. Several of them are biological control agents for control of pest organisms in both open and protected crops all around the world (McMurtry and Croft 1997; McMurtry et al. 2013; Knapp et al. 2018). This family is widespread around the world, presents on all continents except Antarctica, and consists of about 2,500 valid species in 94 genera and three subfamilies (Demite et al. 2020).

Biodiversity survey 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. 2018a, b, c, 2020a, b, c, d; Kreiter and Abo-Shnaf 2020 a, b). In these perspectives, the more interesting area are probably those with a high level of biodiversity. Most of the Indian Ocean constitutes one of the highest world biodiversity area, those area being called hotspots, concept defined by Myers (1988) in order to identify the most immediately important areas for biodiversity conservation. The common characteristics of these hotspots are that they 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 high interest areas in the context of global climate changes may contribute to identify potential biological control agent and future establishment of conservation programs.

Located in the Indian Ocean at around 460 km from the northern coast of Madagascar, Anjouan Island (Ndzuwani or Nzvani in Shikomori) is one of the four main islands constituting Comoros Archipelago, with Mayotte, Mohéli and Grande Comore. No phytoseiid species are known from this island.

The objective of this paper is consequently to present the phytoseiid species found in a survey conducted in November 2018 in Anjouan Island.

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Material and Methods

The samplings took place in Anjouan at the end of November and beginning of December 2018. Plant inhabiting mites were collected from cultivated and wild plants in few locations mainly in the western part of the island.

Mites were directly collected on large leaves and herbaceous plants with a fine brush using either a hand magnifier or a stereoscopic microscope, or on shrubs and trees by beating the plants with very small or spiny leaves. The mites were kept in a black plastic rectangular saucer 45 x 30 cm (Ref. STR 45, BHR, 71370 Saint-Germain-du-Plain, France). The phytoseiid mites were then transferred using a fine brush into small plastic vials containing 1.5 ml of 70% ethanol.

Mites were mounted on slides in Hoyer’s medium, and all examined using a phase and interferential contrast microscope (DMLB, Leica Microsystèmes SAS, Nanterre, France). Characters of specimens were measured using a graded eyepiece (Leica, see above).

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 as well as information on descriptions and re-descriptions were used. The setal nomenclature system adopted was that of Lindquist & Evans (1965) and Lindquist (1994) as adapted by Rowell et al. (1978) and Chant & Yoshida-Shaul (1992) for the dorsum and by Chant & Yoshida-Shaul (1991) for the venter. The notation for solenostomes and poroids is based on Athias-Henriot (1975). Numbers of teeth on the fixed and movable cheliceral digits do not include the respective apical hook. Setae not referred in the results section should be considered as absent. All measurements are given in micrometres (µm) and presented with the mean in bold followed by the range in parenthesis. Only some species with only few measurements mentioned in the literature are provided in this paper.

Classification of plants follows the APG IV classification of 2016 (see for example Byng et al. 2018).

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

The following abbreviations are used in this paper for morphological characters: dsl = dorsal shield length just above j1 to just below J5 along midline; dsw = dorsal shield width at the level of s4; Z4 ser., Z5 ser. = Z4, Z5 serrated (if Z4 and Z5 without ser. = not serrated); gensl = genital shield length; genswst5 = genital shield width at level of setae st5; gensw post. cor. = genital shield width at level of posterior corners; lisl = primary or largest inguinal sigilla (= “metapodal plate”) length; lisw = primary or largest inguinal sigilla (= “metapodal plate”) width; sisl = secondary or smallest inguinal sigilla (= “metapodal plate”) length; vsl = ventrianal shield length; gv3 – gv3 = distance between solenostomes gv3 on the ventrianal shield; vsw ZV2 & vsw anus = ventrianal shield width at ZV2 level and at paranal setae level; scl = calyx total length; scw = calyx widest width; Fdl = fixed digit length; Md1 = movable digit length; Nb teeth Fd = number of teeth on the fixed digit; Nb teeth Md = number of teeth on the movable digit; Shaft = length of the shaft of spermadactyl; toe = length of the toe; BCA = Biological control agent; aasl = altitude above sea level; imm.: immature.

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; INRAE = Institut National de Recherche pour l’Agriculture, l’Alimentation et l’Environnement; INRAPE = Institut National de Recherche pour l’Agriculture, la Pêche et l’Environnement; IRD = Institut de Recherche pour le Développement; MSA = Montpellier SupAgro, France; UMR = Unité Mixte de Recherche; UR = Unité de Recherche.
Results and Discussion

A total of 18 species had been found during this study, all presented thereafter, five of them with new measurements compared to only few references already published.

Subfamily Amblyseiinae Muma

Amblyseiinae Muma 1961: 273.

Tribe Neoseiulini Chant & McMurtry

Neoseiulini Chant & McMurtry 2003a: 6.

Genus Neoseiulus Hughes

Neoseiulus Hughes 1948: 141.

Neoseiulus lula (Pritchard & Baker)

Amblyseius (Amblyseius) lula Pritchard & Baker 1962: 239.
Neoseiulus lula, Schicha 1981b: 212; Moraes et al. 1986: 87, 2004b: 130; Chant & McMurtry 2003a: 27, 2007: 29.
Amblyseius (Amblyseius) insignitus van der Merwe 1968: 138 (synonymy according to Ueckermann & Loots 1988).

This species belongs to the paspalivorus species group of the genus Neoseiulus (Chant and McMurtry 2003a). Its biology remains totally unknown. It is distributed in several countries and islands of sub-Saharan Africa but also in Cuba (Suarez 2004; Moraes et al. 2004a).

Specimens examined: a single ♀ specimen collected during this study. Pomoni, exit of the village (34 m aasl, 12°17′ 01″ S, 44°24′ 52″ E), 1 ♀ on Cymbopogon citratus (De Candolle) Stapf (Poaceae), 30/XI/2018.

Remarks: the measurements of the single female of N. lula (Table 1) fit well with the type materials from Central Africa (Schicha 1981b) and those of specimens from Africa (Zannou et al. 2006) as well as from La Réunion (Kreiter et al. 2020d). When compared to other specimens from sub-Saharan Africa studied by Zannou et al. (2006), our specimen has shorter Z4 and relatively longer ventrianal shield. Specimens from South Africa and Madagascar (van der Merwe 1968; Ueckermann and Loots 1988) have in general greater dimensions than those obtained for specimens from La Réunion (Kreiter et al. 2020d) and Anjouan Islands.

Tribe Kampimodromini Kolodochka

Kampimodromini Kolodochka 1998: 59; Chant & McMurtry 2003b: 189, 2006: 137, 2007: 33.

Subtribe Paraphytoseiina Chant & McMurtry

Paraphytoseiina Chant & McMurtry 2003b: 211.

Genus Paraphytoseius Swirski & Shechter

Paraphytoseius Swirski & Shechter 1961: 113; Moraes et al. 1986: 104, 2004a: 160; Chant & McMurtry 2003b: 216, 2007: 49.
Table 1 Character measurements of adult females of *Neoseiulus lula* collected in this study compared to those obtained in previous studies (localities followed by the number of specimens measured between brackets).

| Characters | Anjouan (1) | Africa (3) | Central Africa (1) | Holotype Congo (1) | La Réunion (1) | South Africa – Madagascar (2?) | South Africa (1) |
|------------|------------|-----------|--------------------|--------------------|---------------|--------------------------------|-----------------|
| Dsl        | 373        | 386 (381 – 393) | 381 | 389 | 385 | 397 | 377 |
| Dsw        | 183        | 196 (182 – 211) | 157 | 191 | 188 | 195 | 204 |
| j1         | 20         | 21 (19 – 23)   | 21 | 19 | 23 | 24 | 21 |
| j3         | 20         | 23 (22 – 24)   | 23 | 22 | 23 | 24 | 21 |
| j4         | 13         | 15 (14 – 16)   | 15 | 14 | 15 | 16 | 12 |
| j5         | 13         | 14 (13 – 16)   | 14 | 14 | 15 | 16 | 13 |
| j6         | 16         | 18 (18 – 19)   | 17 | 17 | 13 | 16 | 17 |
| J2         | 19         | 19 (19 – 20)   | 20 | 18 | 18 | 21 | 18 |
| J5         | 14         | 11 (10 – 13)   | 14 | 13 | 13 | 16 | 11 |
| r3         | 18         | 21 (19 – 22)   | 21 | 24 | 20 | 24 | 20 |
| R1         | 20         | 22 (20 – 24)   | 21 | 21 | 20 | 24 | 20 |
| S4         | 22         | 25 (23 – 27)   | 25 | 25 | 25 | 27 | 22 |
| S2         | 25         | 27 (25 – 29)   | 27 | 25 | 20 | 29 | 25 |
| S4         | 28         | 28 (26 – 30)   | 26 | 28 | 25 | 29 | 24 |
| S5         | 25         | 27 (26 – 29)   | 28 | 25 | 25 | 29 | 22 |
| Z5         | 58         | 65 (64 – 66)   | 65 | 65 | 65 | 70 | 62 |
| st1-st1    | 47         | –              | –   | 48 | –   | –   | –   |
| st2-st2    | 58         | 61 (58 – 64)   | 67 | 59 | 63 | –   | –   |
| st3-st3    | 65         | –              | –   | –   | 70 | 67 | –   |
| st1-st3    | 75         | 77 (77 – 78)   | 78 | 78 | 75 | 92 | –   |
| st4-st4    | 72         | –              | –   | 68 | –   | –   | –   |
| Gensl      | 115        |               |     |     |     |     |     |
| Gensw st5  | 70         |               |     |     |     |     |     |
| Gensw post. corn. | 72       |               |     |     |     |     |     |
| st5-st5    | 65         | 67 (62 – 70)   | –   | 66 | 70 | 77 | –   |
| Lisl       | 30         | –              | 28 | –   | 28 | –   | –   |
| Lisw       | 4          | –              | –   | 5   | –   | –   | –   |
| Sisl       | 12         | –              | 10 | –   | 10 | –   | –   |
| Vsl        | 130        | 107 (102 – 110)| 135 | 138 | 138 | 142 | –   |
| Vsw Zv2    | 110        | 85 (77 – 91)   | 109 | 107 | 110 | 107 | –   |
| Vsw anus   | 83         | –              | 86 | 88 | –   | –   | –   |
| JV5        | 33         | –              | 35 | –   | 38 | 40 | –   |
| StIV       | 53         | 56 (53 – 59)   | 54 | 55 | 53 | 65 | 50 |
| Sc1        | 3          | 5              | 2  | –   | 3  | 5  | –   |
| Sc2        | 10         | 11 (11 – 12)   | 12 | –   | 12 | 14 | –   |
| Fdl        | 30         | 32             | 35 | –   | 38 | –   | –   |
| No teeth Fd| 7          | 8              | –   | 8   | –   | 06-jul | –   |
| Mdl        | 33         | 35             | 35 | –   | 30 | –   | –   |
| No teeth Md| 1          | 1              | –   | 1   | 0?  | –   | –   |

Sources of measurements – Africa (Benin 2♀, Tanzania 1♀) and Holotype Congo: Zannou et al. (2006); Central Africa: Schicha (1981b); South Africa-Madagascar (identified as *N. insignitus*, synonymized by Ueckermann & Loots 1988); van der Merwe (1968); South Africa: Ueckermann & Loots (1988); – : not provided.
**Paraphytoseius horrifer** (Pritchard & Baker)

*Amblyseius (Ptenoseius) horrifer* Pritchard & Baker 1962: 295.  
*Amblyseius horrifer*, Meyer & Rodrigues 1966: 30.  
*Amblyseius (Paraphytoseius) horrifer*, van der Merwe 1968: 169.  
*Proprioseius (Paraphytoseius) horrifer*, Karg 1983: 302.  
*Paraphytoseius horrifer*, Moraes et al. 1986: 105, 2004b: 152; Chant & McMurtry 2003b: 220, 2007: 53.

Our specimens of *Paraphytoseius* should be placed the *orientalis* species group by the absence of setae S5 (Chant and McMurtry 2003b). As suggested by Chant and McMurtry (2003b) and Moraes *et al.* (2007), we consider that *P. horrifer* and *P. orientalis* are different valid species. All our specimens have long setae s4, Z4, Z5, and no distinctly short, thick, spatulate macroseta on genu I. They all belong consequently to the former species. This species is widely distributed in Sub-Saharan Africa and Madagascar. The biology of *P. horrifer* remains totally unknown. It was mentioned recently for the first time from several countries: La Réunion (Kreiter *et al.* 2020d), Mauritius (Kreiter and Abo-Shnaf 2020b), Rodrigues (Kreiter and Abo-Shnaf 2020a) Islands and Vietnam (Kreiter *et al.* 2020c).

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

**Specimens examined**: 36 specimens (34 ♀♀ and 2 ♂♂) collected during this study. Tsembehou, inside the village (446 m aasl, 12°12′27″ S, 44°27′54″ E), 34 ♀♀ and 2 ♂♂ on *Clerodendrum speciosissimum* Van Geert ex Morren (Lamiaceae), 29/IX/2018.

**Remarks**: morphological and morphometric characters and all measurements fit well with those mentioned by Kreiter *et al.* (2020c, d). This species described from Africa (Pritchard & Baker 1962) was first mention in the Indian Ocean from La Réunion Island (Kreiter *et al.* 2020d) but seems to be present in Rodrigues, Mauritius and Mayotte (Kreiter and Abo-Shnaf 2020a, b; Kreiter *et al.* 2020a) and actually in at least one island of Comoros Archipelago. This is the most abundant species in Anjouan Island but all specimens were collected only in one sample site.

**Tribe Amblyseiini Muma**

Amblyseiinae Muma 1961: 273 and Amblyseiini Muma, Wainstein 1962: 26.

**Subtribe Amblyseiina Muma**

Amblyseiina Muma, Chant & McMurtry 2004a: 179.

**Genus Amblyseius Berlese**

*Amblyseius* Berlese 1914: 143.

**Amblyseius duplicisetus** Moraes & McMurtry

*Amblyseius duplicisetus* Moraes & McMurtry 1988: 13; Moraes *et al.* 2004a: 143, 2004b: 22; Zannou *et al.* 2007: 10; El-Banhawy & Knapp 2011: 25. *Amblyseius duplicisetus* [sic], Chant & McMurtry 2004a: 208, 2007: 78.

*Amblyseius duplicisetus* belongs to the *largoensis* species group and to the *largoensis* species subgroup (Chant and McMurtry 2004a, 2007). It was found in Kenya (Moraes and McMurtry 1988; Zannou *et al.* 2007; El-Banhawy and Knapp 2011) and in Sri Lanka (Moraes *et al.* 2004a). Its biology is totally unknown. This is the first mention of that species in Indian Ocean Islands.

**World distribution**: Kenya, Sri Lanka.
Specimens examined: 18 specimens (13 ♀♀ and 5 ♂♂) collected during this study. Tsembehou, inside the village (446 m asl, 12°12'27" S, 44°27'54" E), 1 ♀ on Mangifera indica L. (Anacardiaceae), 29/XI/2018; Chandra, inside the village (448 m asl, 12°11'56" S, 44°24'52" E), 2 ♀♀ and 1 ♂ on Acalypha wilkesiana Müller Argovisiensis (Euphorbiaceae), 29/XI/2018; Pomoni, exit of the village (34 m asl, 12°17'01" S, 44°24'52" E), 2 ♀♀ and 1 ♂ on Artocarpus heterophyllus Lamarc (Moraceae), 1 ♀ and 1 ♂ on Artocarpus altillis (Parkinson) Fosberg (Moraceae), 1 ♀ on Theobroma cacao L. (Malvaceae), 2 ♀♀ on Syzygium aromaticum (L.) Merrill and Perry (Myrtaceae) and 4 ♀♀ and 2 ♂♂ on an unknown tree with alternate leaves, 30/XI/2018.

Remarks: this is the second abundant species after P. horrifer but contrary to the later, the former was found in several sites. All measurements (Table 2) fit well with those already published on this species with only very slight variations (Moraes and McMurry 1988; Moraes et al. 2004a; Zannou et al. 2007; El-Banhawy and Knapp 2011). Measurements of female specimens of Anjouan are very similar with those collected from Kenya and Sri Lanka, except with shorter setae s4, Z4 and Z5. The male was already known, described and drawn by El-Banhawy and Knapp (2011) for the first time based on few measurements. We report here a complete set of measurements based on our 5 specimens to provide a full description (Table 3).

**Amblyseius herbicolus (Chant)**

Typhlodromus (Amblyseius) herbicolus Chant 1959: 84. Amblyseius (Amblyseius) herbicolus, Muma 1961: 287. Typhlodromus herbicolus, Hirschmann 1962: 23.

| Table 2 Character measurements of adult females of *Amblyseius duplicicetus* collected in this study with those obtained from previous studies (localities followed by the number of specimens measured between brackets). |
|---|---|---|---|
| Characters | Anjouan (13) | Kenya 1 (2) | Kenya 2 (1) | Kenya 3 (1?) | Sri Lanka (3) |
| ‌ | (this study) | | | | |
| Dsl | 349 (328 – 368) | 360 | 364 | 335 | 352 (335 – 380) |
| Dow | 226 (200 – 243) | 240 | 259 | 196 | 242 (225 – 257) |
| j1 | 38 (34 – 40) | 42 (41 – 43) | 43 | 46 | 39 (36 – 42) |
| j2 | 47 (43 – 49) | 47 (43 – 51) | 54 | 50 | 46 (43 – 50) |
| j4 | 8 (6 – 10) | 8 (7 – 10) | 6 | 4 – 6 | 7 (7 – 8) |
| j5 | 6 (5 – 6) | 8 (7 – 10) | 6 | 4 – 6 | 6 |
| j6 | 8 (5 – 9) | 8 (7 – 10) | 8 | 4 – 6 | 7 (7 – 8) |
| Z2 | 9 (8 – 10) | 11 (10-12) | 11 | 4 – 6 | 10 |
| Z5 | 10 (8 – 12) | 11 (10-12) | 8 | 4 – 6 | 9 |
| r3 | 12 (10 – 15) | 12 | 11 | 10 | 15 (13 – 16) |
| R1 | 10 (8 – 12) | 10 | 10 | 10 | 12 (12 – 13) |
| s4 | 80 (75 – 88) | 106 (103 – 109) | 109 | 102 | 97 (93 – 100) |
| S2 | 15 (10 – 18) | 12 | 11 | 7 | 13 |
| S4 | 12 (10 – 15) | 12 | 11 | 7 | 12 |
| S5 | 10 (8 – 13) | 11 | 11 | 7 | 9 (9 – 10) |
| c2 | 10 (9 – 12) | 11 (10 – 12) | 10 | 4 – 6 | 9 |
| c5 | 7 (5 – 9) | 8 (7 – 10) | 6 | 4 – 6 | 6 (5 – 6) |
| Z1 | 11 (9 – 13) | 12 | 8 | 8 | 12 (12 – 13) |
| Z4 | 73 (70 – 76) | 98 (96 – 100) | 102 | 90 | 89 (87 – 90) |
| Z5 | 286 (275 – 308) | 325 (310 – 336) | 330 | 304 | 300 (290 – 308) |
| st-1 | 60 (54 – 65) | – | – | – | – |
| st-2 | 69 (63 – 73) | 67 | 74 | 70 | 66 (65 – 67) |
| st-3 | 70 (63 – 73) | – | – | – | – |
| st-4 | 67 (64 – 70) | 62 | 66 | 55 | 64 (62 – 66) |
| st-5 | 70 (55 – 85) | – | – | – | – |
| Genl | 123 (115 – 133) | – | – | – | – |
| Genm | 74 (65 – 85) | – | – | – | – |

Sources of measurements – Kenya 1: Mora & McMurry (1988); Kenya 2: Zannou et al. (2007). Kenya 3: El-Banhawy & Knapp (2011); Sri Lanka: Moraes et al. (2004a); –: not provided.
Amblyseius herbicolus, Moraes et al. 1986: 14, 1989: 79, 2004b: 27; Chant & McMurtry 2004: 208, 2007: 78; Doker et al. 2020: in press.

Typhlodromus (Amblyseius) amitae Chaudhri 1968: 553 (synonymy according to Daneshvar & Denmark 1982).

Amblyseius deleoni Muma & Denmark 1970: 68 (synonymy according to Daneshvar & Denmark 1982).

Amblyseius giganticus Gupta 1981: 33 (synonymy according to Gupta 1986).

Amblyseius (Amblyseialus) thermophilus Karg 1991: 12 (synonymy according to El-Banhawy & Knapp 2011).

This species belongs to the largoensis species group as setae J2 and Z1 are present, setae s4 are minute and the ventrial 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 ventrianal shield is entire (Chant and McMurtry 2004).

Amblyseius herbicolus is widespread in all tropical and subtropical regions of the world. It is the second most abundant phytoseiid mites on Coffea arabica L. in Brazil, associated with Brevipalpus phoenicis (Geijskes), vector of the coffee ring spot virus 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

| Characters | Anjouan (5) | Kenya (1) |
|------------|-------------|-----------|
| Dsl        | 267 (262 – 275) | –         |
| Dsw        | 170 (150 – 183) | –         |
| j1         | 31 (29 – 33)   | –         |
| j3         | 44 (43 – 45)   | –         |
| j4         | 8             | –         |
| j5         | 5 (5 – 6)      | –         |
| j6         | 8             | –         |
| J2         | 9 (8 – 10)     | –         |
| J5         | 8 (8 – 9)      | –         |
| r3         | 10 (8 – 11)    | –         |
| R1         | 10 (9 – 11)    | –         |
| s4         | 67 (63 – 70)   | –         |
| S2         | 11 (10 – 12)   | –         |
| S4         | 10 (9 – 11)    | –         |
| S5         | 8 (7 – 8)      | –         |
| z2         | 9 (8 – 10)     | –         |
| z4         | 9 (8 – 10)     | –         |
| z5         | 5 (5 – 6)      | –         |
| Z1         | 9 (8 – 10)     | –         |
| Z4         | 62 (60 – 65)   | –         |
| Z5         | 219 (200 – 238)|--         |
| st1-st1    | 51 (50 – 53)   | –         |
| st2-st2    | 54 (50 – 55)   | –         |
| st3-st3    | 55 (51 – 58)   | –         |
| st1-st5    | 114 (112 – 118)| –         |
| st4-st4    | 35 (31 – 37)   | –         |
| st5-st5    | 31 (30 – 33)   | –         |
| Vsl        | 113 (110 – 118)| 122       |
| Vsw        | 147 (138 – 158)| 160       |
| Vsw anus   | 55 (50 – 60)   | –         |
| gv3 – gv3  | 23 (20 – 25)   | –         |
| JV5        | 39 (34 – 45)   | –         |
| Sgel       | 36 (34 – 40)   | –         |
| StI        | 30             | –         |
| SgelII     | 31 (30 – 33)   | –         |
| StII       | 25             | –         |
| SgelIII    | 38 (37 – 38)   | –         |
| StIII      | 33 (32 – 33)   | –         |
| StIV       | 28             | –         |
| SgelIV     | 95 (93 – 98)   | –         |
| StIV       | 74 (70 – 78)   | –         |
| StV        | 53 (50 – 55)   | –         |
| Fdl        | 23 (22 – 23)   | –         |
| No teeth Fd| 8              | –         |
| Mdl        | 22 (21 – 23)   | –         |
| No teeth Md| 3              | –         |
| Shaft      | 19 (18 – 20)   | 14        |
| Foot       | 5              | 5         |
| Toe        | 3              | 3         |

Sources of measurements – Kenya: El-Banhawy & Knapp (2011); – : not provided.
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 maintains 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 (*Tetranychus urticae* Koch). 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 previously recorded in a lot of countries of the world and especially in French West Indies (Moraes et al. 2000, Kreiter et al. 2006) and in Comoros Archipelago in Grande Comore Island (Kreiter et al. 2018b).

**World distribution:** Argentina, Australia, Azores, Benin, Brazil, Burundi, Canary Islands, China, Colombia, Grande Comore Island, Costa Rica, Dominican Republic, Dr Congo, El Salvador, Ghana, Guadeloupe Island, Guatemala, Hawaii, Honduras, India, Iran, Kenya, Les Saintes, La Réunion and Madagascar Islands, 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:** five specimens (5 ♀♀) collected during this study. Dindi, inside the village (567 m aasl, 12°12′56″ S, 44°27′02″ E), 2 ♀♀ on *Clidemia hirta* (L.) Don (Melastomataceae), 29/XI/2018; Chandra, inside the village (448 m aasl, 12°11′56″ S, 44°27′52″ E), 2 ♀♀ on *Codiaeum variegatum* (L.) De Jussieu (Euphorbiaceae) and 1 ♀ on *Acalypha wilkesiana* Müller Argoviensis (Euphorbiaceae), 29/XI/2018.

**Remarks:** this species was reported by Kreiter et al. (2018b) in the Grande Comore Island of the Comoros Archipelago in the Indian Ocean based on two females. This is interesting to notice that no male were collected, just like in La Réunion Island (Kreiter et al. 2020c) and also on Citrus in Black Sea Region of Turkey (Doker et al. 2020). *Amblyseius herbicolus* was reported in the past from La Réunion Island from few specimens (Quilici et al. 1997, 2000) and more recently from a lot of specimens (Kreiter et al. 2020d). It is also reported recently from Vietnam (Kreiter et al. 2020c), Rodrigues and Maurice Islands (Kreiter and Abo-Shnaf 2020a, b) but only from females. Morphological and morphometric characters and all measurements fit well with those measurements provided in Kreiter et al. (2018b, 2020c, d).

**Amblyseius largoensis** (Muma)

*Amblyseiopsis largoensis* Muma 1955: 266.
*Typhlodromus* (*Amblyseius*) *largoensis*, Chant 1959: 96.
*Amblyseius* (*Amblyseiulus*) *largoensis*, Muma 1961: 287.
*Typhlodromus largoensis*, Hirschmann 1962: 2.
*Amblyseius* (*Amblyseius*) *largoensis*, Ehara 1966: 22.
*Amblyseius largoensis*, Swirski & Golan 1967: 225; Moraes et al. 1986: 17, 2004b: 33; Chant & McMurtry 2004: 208, 2007: 78.
*Amblyseius magnolia* Muma 1961: 289 (synonymy by Denmark & Evans 2011).
Amblyseius sakalava Blommers 1976: 96 (synonymy by Ueckermann & Loots 1988).  
Amblyseius antalaensis Gupta 1977: 53 (synonymy by Gupta 1986).

Amblyseius largoensis belongs to the largoensis species group and to the largoensis species subgroup. 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 and as a potential BCA of Raoiella indica Hirst in La Réunion Island (Moraes et al. 2012). Using morphometric analyses of 36 characters, molecular analyses and crossing tests, Navia et al. (2014) studied specimens collected in 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. This species was previously recorded from Mauritius Island by Ferragut and Baumann (2019) and Kreiter and Abo-Shnaf (2020b), from Rodrigues Island by Kreiter and Abo-Shnaf (2020a) and from Mayotte by Kreiter et al. (2020a) based on males and females records.

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

**Specimens examined:** a single ♂ specimen collected during this study. **Dindi**, inside the village (567 m aasl, 12°12’56” S, 44°27’02” E), 1 ♂ on Manihot esculenta Crantz (Euphorbiaceae), 29/XI/2018.

**Remarks:** morphological and morphometric characters and all measurements of the Anjouan specimen fit well with those given in Zannou et al. (2007) for specimens from Africa, Navia et al. (2014) for specimens from Brazil, La Réunion and Trinidad & Tobago, by Ferragut and Baumann (2019) and Kreiter and Abo-Shnaf (2020b) for specimens from Mauritius Island, by Kreiter and Abo-Shnaf (2020a) for specimens from Rodrigues Island and by Kreiter et al. (2020a) for specimens from Mayotte Island. Schicha (1981c) has given a detailed description of A. herbicolus (under the name A. deleoni Muma and Denmark). He states that, whereas the male of A. deleoni has been described from Florida by Muma and Denmark (1970), it has not been found on leaf samples taken regularly over 5 years from citrus trees on the central coast of New South Wales (Schicha 1981c). Similarly, Blommers (1976) failed to observe males in the mass rearing of this species in Madagascar. Ferragut and Baumann (2019), Kreiter et al. (2020d) and Kreiter and Abo-Shnaf (2020b) never recorded a single male among several hundred specimens collected in La Réunion and Mauritius, respectively. Occurrence of males in natural populations of A. herbicolus, a thelytokous species after several author, is questioned. Amblyseius largoensis is a species also very common in the Islands of Indian Ocean very often recorded in several Islands (Kreiter and Abo-Shnaf 2020a, b; Kreiter et al. 2020a, b). We consequently consider that the single specimen collected in Anjouan which setae length is in accordance with description of the male of that species, is a male of A. largoensis. But as females were not collected in the same time, a doubt is still existing on the occurrence of that species, which must be confirmed in further more surveys in more locations.

**Amblyseius parasundi** Blommers

Amblyseius (Proprioseiopsis) parasundi Blommers 1974: 144.  
Amblyseius parasundi, Moraes et al. 1986: 27, 2004a: 46.  
Amblyseius (Amblyseius) parasundi, Denmark & Muma 1989: 19.

This species belongs to the sundi species group by the absence of setae Z1 and sundi species subgroup by having an elongated and a tube-like spermatheca. Despite mentioning it as abundant on fruit trees in Madagascar preying on tetranychid mites (Blommers and Gutierrez 1975), its biology is totally unknown.

**World distribution:** Madagascar Island.

**Specimens examined:** seven specimens (5 ♀♀ and 2 imm.) collected during this study. **Tsembehou**, inside the village (446 m aasl, 12°12’27” S, 44°27’54” E), 2 ♀♀ on Theobroma

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cacao L. (Malvaceae), 1 ♀ and 1 imm. on *Litchi chinensis* Sonnerat (Sapindaceae), 29/XI/2018; *Chandra*, inside the village (448 m aasl, 12°11′56″ S, 44°27′52″ E), 2 ♀♀ and 1 imm. on *Citrus limon* (L.) Burman (Rutaceae), 29/XI/2018.

**Remarks:** morphological and morphometric characters and all measurements fit well with few measurements values mentioned in the literature (Blommers 1974, Denmark and Muma 1989) as well as with specimens from Mayotte Island (Kreiter *et al.* 2020a). *Amblyseius parasundi* is reported by Blommers (1974) as being a thelytokous species in mass-rearing and field collected specimens and this information is also mentioned in Denmark and Muma (1989).

**Tribe Euseiini Chant & McMurtry**

Euseiini Chant & McMurtry 2005a: 191.

**Subtribe Euseiina Chant & McMurtry**

Euseiina Chant & McMurtry 2005a: 209.

**Genus Euseius Wainstein**

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

**Euseius hima (Pritchard & Baker)**

*Amblyseius* (*Amblyseius*) *hima* Pritchard & Baker 1962: 257; Blommers 1976: 89. *Euseius hima*, Moraes *et al.* 1986: 46, 2004b: 71; Quilici *et al.* 2000: 99; Chant & McMurtry 2005a: 215, 2007: 121.

This species was recorded from several countries of Sub-Saharan Africa, but also from Madagascar, India (Demite *et al.* 2020) and La Réunion (Quilici *et al.* 2000). Its biology remains totally unknown.

**World distribution:** Cameroon, Equatorial Guinea, La Réunion Island, Madagascar Island.

**Specimens examined:** 11 specimens (7 ♀♀, 1 ♂ and 3 imm.) collected during this study. *Moutsamoudou*, Chitsanguani (34 m aasl, 12°09′34″ S, 44°24′20″ E), 3 ♀♀ and 3 imm. on *Lantana camara* L. (Verbenaceae), 28/XI/2018; *Dindi*, inside the village (567 m aasl, 12°12′56″ S, 44°27′02″ E), 2 ♀♀ and 1 ♂ on *L. camara*, 29/XI/2018; *Tsembehou*, inside the village (446 m aasl, 12°12′27″ S, 44°27′54″ E), 1 ♀ on *Mangifera indica* L. (Anacardiaceae), 29/X/2018; *Pomoni*, exit of the village (34 m aasl, 12°17′01″ S, 44°24′52″ E), 1 ♀ on *Syzygium jambos* (L.) Alston (Myrtaceae), 30/XI/2018.

**Remarks:** Morphological and morphometric characters of our specimens fit well with measurements published in Kreiter *et al.* (2020d) and with measurements of specimens from Mauritius Island (Kreiter and Abo-Shnaf 2020b).

**Sub-tribe Typhlodromalina Chant & McMurtry**

Typhlodromalina Chant & McMurtry 2005a: 195.

**Genus Typhlodromalus Muma**

*Amblyseius* (*Typhlodromalus*) Muma 1961: 288; *Typhlodromalus* De Leon 1966: 87.

**Typhlodromalus spinosus (Meyer & Rodrigues)**

*Amblyseius spinosus* Meyer & Rodrigues 1966: 30; Moraes *et al.* 1986: 31. *Kampimodromus spinosus*, Quilici *et al.* 2000: 100. *Typhlodromalus spinosus*, Moraes *et al.* 2004b: 204; Chant & McMurtry 2005a: 199, 2007: 111.
This species belongs to the *athiasae* species group as setae *J1* and *S5* are absent. This species group contains six species (Chant and McMurtry 2005a, Moraes *et al.* 2006).

*Typhlodromalus spinosus* was collected from Eastern, Western, but mainly Southern Africa and La Réunion (Demite *et al.* 2020). The rapid multiplication of this species on the western flower thrips (WFT), *Frankliniella occidentalis* Pergande, was confirmed and clear evidence that *T. spinosus* predates on WFT under laboratory and field conditions, but not on *T. urticae* (Mwangi *et al.* 2015). It seems to be abundant in low vegetation as it was found in high populations in a study of companion plants in citrus orchard (Le Bellec *et al.* unpub. data).

This species have never been recorded from Guadeloupe or Martinique in similar studies, but it is interesting to notice that in those islands, another *Typhlodromalus* was collected, *T. peregrinus* (Muma) (Mailloux *et al.* 2020; Kreiter *et al.* 2013, 2018c). *Typhlodromalus spinosus* was recorded from La Réunion by Quilici *et al.* (2000) and was then find in quite high numbers by Kreiter *et al.* (2020d) and in few numbers from Mauritius Island (Kreiter and Abo-Shnaf 2020b).

**World distribution:** Benin, Burundi Dr Congo, Kenya, Malawi, Mozambique, La Réunion Island.

**Specimens examined:** a single ♀ specimen collected during this study. Dindi, inside the village (567 m aasl, 12°12′56″ S, 44°27′02″ E), 2 ♀♀ on *Lantana camara* L. (Verbenaceae), 29/XI/2018.

**Remarks:** this species was described from Mozambique (Meyer and Rodrigues 1966), then mentioned in the Indian Ocean from La Réunion (Quilici *et al.* 2000; Kreiter *et al.* 2020d) and Mauritius (Kreiter and Abo-Shnaf 2020b). Morphological and morphometric characters of our specimens fit well those provided by Kreiter *et al.* (2020d).

**Genus Ueckermannseius Chant and McMurtry**

*Ueckermannia* Chant & McMurtry 2005a: 201. Preoccupied by *Ueckermannia* Kaźmierski, 1996 (Tydeidae).

*Ueckermannseius* Chant & McMurtry 2005b: 337, 2007: 115.

*Ueckermannseius eastafricae* Moraes, Zannou & Oliveira 2006: 30.

This species was described from Uganda and Kenya (Moraes *et al.* 2006) and recovered only once in Kenya (El-Banhawy *et al.* 2009). Its biology is totally unknown.

**World distribution:** Kenya, Uganda.

**Specimens examined:** two specimens (2 ♀♀) collected during this study. Pomoni, exit of the village (34 m aasl, 12°17′01″ S, 44°24′52″ E), 1 ♀ on *Gliricidia sepium* (Jacquin), Kunth ex Walpers (Fabaceae) and 1 ♀ *Hibiscus tiliaceus* L. (Malvaceae), 30/XI/2018.

**Remarks:** morphological and morphometric characters of our specimens (Table 4) fit well with those provided by Moraes *et al.* (2006) except smaller setae *j4, j5, j6, R1, s4, S2, z2, z4, z5, SgeII, SgeIII* and smaller dorsal and ventrianal shields and cheliceral digits.

**Subfamily Phytoseiinae Berlese**

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

**Genus Phytoseius Ribaga**

*Phytoseius* Ribaga 1904: 177.

*Phytoseius amba* Pritchard & Baker 1962: 224; Blommers 1976: 85; *Phytoseius* (Phytoseiina) *amba*, Denmark 1966: 49;
Typhlodromus (Pizytoseius) amba, van der Merwe 1968: 101; Phytoseius amba, Swirski & Ragusa 1978: 408; Pennaseius amba, Matthysse & Denmark 1981: 352; Phytoseius amba, Moraes et al. 1986: 210, 2004b: 232; Chant & McMurtry 2007: 129.

This species belongs to the plumifer species group (Chant and McMurtry 1994) as setae R1 and J2 are present. Species of the genus Phytoseius are supposed to belong to the Type III species (McMurtry and Croft 1997; McMurtry et al. 2013), i.e. a polyphagous generalist predator. However, the biology of Phytoseius amba remains totally unknown.

**World distribution:** Benin, Burundi, Cameroon, Cape Verde, DR Congo, Kenya, Madagascar Island, Malawi, Mozambique, Nigeria, Reunion Island, Rwanda, Senegal, South Africa, Zambia, Zimbabwe.

**Specimens examined:** three specimens (3 ♀♀) collected during this study. Pomoni, exit of the village (34 m aasl, 12°17′01″ S, 44°24′52″ E), 3 ♀♀ on an unknown tree with alternate leaves, 30/XI/2018.

**Remarks:** Measurements of the three adult females agree well with measurements mentioned in the literature, especially with those of Ueckermann et al. (2007) obtained with

| Characters | Anjouan (2) (this study) | Africa (7) | Characters | Anjouan (2) (this study) | Africa (7) |
|------------|--------------------------|------------|------------|--------------------------|------------|
| Dsl        | 333 – 338                | 390 (336 – 405) | Gensl      | 128 – 138                | –          |
| Dsw        | 170 – 195                | 274 (258 – 291) | Gensw st5  | 80                       | –          |
| j1         | 34 – 35                  | 34 (30 – 38)  | Gensw post. corn. | 80 – 85              | –          |
| j3         | 22 – 24                  | 23 (19 – 27)  | st5-st5    | 75 – 81                  | 80 (67 – 90) |
| j4         | 8 – 10                   | 15 (11 – 18)  | Lisl       | 28                       | –          |
| j5         | 8 – 10                   | 14 (10 – 19)  | Lisw       | 2 – 4                    | –          |
| j6         | 9 – 11                   | 12 (10 – 16)  | Sisl       | Not visible              | –          |
| J2         | 12 – 13                  | 13 (10 – 16)  | Vsl        | 90 – 95                  | 122 (96 – 130) |
| J5         | 6 – 7                    | 5 (3 – 6)     | Vsw ZV2    | 60                       | 78 (67 – 85) |
| r3         | 15 – 18                  | 18 (16 – 21)  | Vsw anus   | 65 – 75                  | 71 (62 – 75) |
| R1         | 13                      | 18 (14 – 21)  | JV5        | 28 – 30                  | –          |
| s4         | 21 – 23                  | 26 (19 – 35)  | SgeI       | 20 – 23                  | –          |
| S2         | 13 – 15                  | 18 (16 – 22)  | SgeII      | 22 – 23                  | 28 (24 – 34) |
| S4         | 13 – 15                  | 17 (14 – 21)  | SgeIII     | 31 – 33                  | 39 (37 – 45) |
| S5         | 13 – 15                  | 16 (14 – 21)  | StiIII     | 28 – 30                  | 31 (29 – 37) |
| z2         | 13 – 15                  | 20 (16 – 24)  | SgeIV      | 43 – 53                  | 57 (51 – 62) |
| z4         | 13 – 15                  | 21 (13 – 29)  | StiIV      | 40 – 45                  | 44 (34 – 56) |
| z5         | 10                      | 14 (13 – 16)  | StIV       | 70                       | 58 (51 – 69) |
| Z1         | 11 – 13                  | 16 (13 – 21)  | Scl        | 30 – 37                  | 35          |
| Z4         | 13 – 14                  | 16 (11 – 19)  | Scw        | 11 – 14                  | –          |
| Z5         | 43                      | 39 (32 – 53)  | Fdl        | 25 – 26                  | 34 (33 – 35) |
| st1-st1    | 55                      | –            | Nb teeth Fd | Not visible             | 10          |
| st2-st2    | 63 – 65                  | 72 (69 – 80)  | Mdl        | 23 – 28                  | 38          |
| st3-st3    | 75                      | –            | Nb teeth Md | Not visible             | 4           |
| st1-st3    | 63 – 65                  | 71 (62 – 77)  | –          | –                       | –          |
| st4-st4    | 75 – 81                  | –            | –          | –                       | –          |

**Sources of measurements – Africa (Uganda 2♀♀, Kenya 5♀♂):** Moraes et al. (2006); – : not provided.
a large number of specimens (29) from various countries in Africa with those of Kreiter et al. (2020d) for specimens from La Réunion and with those of Kreiter et al. (2018b) for specimens from Grande Comore.

**Phytoseius crinitus Swirski & Shechter**

*Phytoseius (Dubininellus) crinitus* Swirski & Shechter 1961: 102.  
*Phytoseius crinitus*, Amitai & Swirski 1966: 21; Denmark 1966: 66; Swirski & Amitai 1966: 11; Moraes et al. 1986: 220, 2004: 236; Chant & McMurtry 2007: 129.

As the previous species, this species belongs also to the *horridus* species group (Chant and McMurtry 1994). It was recorded in several countries of Asia, in Burundi, Madagascar (Demite et al. 2020) and La Réunion (Quilici et al. 2000). Its biology remains totally unknown. It was recently recorded in Mauritius Island by Ferragut and Baumann (2019).

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

**Specimens examined**: a single ♀ specimen collected during this study. Pomoni, exit of the village (34 m aasl, 12°17′01″ S, 44°24′52″ E), 1 ♀ on *Hibiscus tiliaceus* L. (Malvaceae), 30/XI/2018.

**Remarks**: this species was the more numerous species of *Phytoseius* collected in Mauritius by Ferragut and Baumann (2019) and Kreiter and Abo-Shnaf (2020b). It was reported for the first time by these authors from Mauritius, but was already reported by Quilici et al. (2000) from Mascareignes Archipelago in La Réunion Island where Kreiter et al. (2020d) had recovered the species, and from Rodrigues Island (Kreiter and abo-Shnaf 2020a). Morphological and morphometric characters of our specimens fit well with those provided by Ueckermann et al. (2007) and Kreiter et al. (2020d).

**Subfamily Typhlodrominae Wainstein**

Typhlodromini Wainstein 1962: 26; Typhlodrominae Chant & McMurtry 1994: 235.

**Tribe Chanteiini Chant & McMurtry**

Chanteiini Chant & McMurtry 1994: 237, 2007: 132.

**Genus Chanteius Wainstein**

*Chanteius* Wainstein 1962: 19.

**Chanteius contiguus (Chant)**

*Typhlodromus (Typhlodromus) contiguus* Chant 1959: 29.  
*Typhlodromus (Diadromus) contiguus*, Athias-Henriot 1960: 62.  
*Typhloseiopsis contiguus*, Muma 1961: 294.  
*Chanteius (Chanteius) contiguus*, Wainstein 1962: 9.  
*Typhlodromus contiguus*, Hirshmann 1962: 2.  
*Typhlodromus (Typhloseiopsis) contiguus*, Pritchard & Baker 1962: 222.  
*Diadromus contiguus*, Chant & Yoshida-Shaul 1986: 2030, Moraes et al. 1986: 184.  
*Chanteius contiguus*, Moraes et al. 2004b: 261; Chant & McMurtry 1994: 239.  
*Chanteius lieni* (Tseng 1976): 97 (synonymy according to Chant & Yoshida-Shaul 1986).

This species belongs to the *contiguus* species group (Chant and McMurtry 1994) and its biology remains totally unknown.

**World distribution**: China, Hong-Kong, Japan, Madagascar, Philippines, Singapore.

**Specimens examined**: 11 specimens (10 ♀♀ and 1 ♂) collected during this study. Moutsamoudou, Chitsanguani (34 m aasl, 12°09′34″ S, 44°24′20″ E), 1 ♀ on *Lantana*
camara L. (Verbenaceae), 28/XI/2018; Tsembehou, inside the village (446 m aasl, 12°12’27” S, 44°27’54” E), 1 ♀ on Mangifera indica L. (Anacardiaceae), 4 ♀♀ and 1 ♂ on Syzygium aromaticum (L.) Merrill and Perry (Myrtaceae), 29/XI/2018; Chandra, inside the village (448 m aasl, 12°11’56” S, 44°27’52” E), 1 ♀ on Vitis vinifera L. (Vitaceae), 29/XI/2018; Pomoni, exit of the village (34 m aasl, 12°17’01” S, 44°24’52” E), 1 ♀ on Psidium cattleianum Afzelius ex Sabine (Myrtaceae), 2 ♀♀ on Piper nigrum L. (Piperaceae) and 1 ♂ on Syzygium jambos (L.) Alston (Myrtaceae), 30/XI/2018.

Remarks: morphological and morphometric characters of our specimens fit well with those of numerous descriptions and redescriptions available in the literature, especially those by Blommers (1976) for specimens from Madagascar. This species was reported only from South-East Asia and Madagascar. This is the second report of this species in the Indian Ocean outside Madagascar after Mayotte Island (Kreiter et al. 2020a).

Tribe Typhlodromini Wainstein

Typhlodromini Wainstein 1962: 26.

Genus Typhlodromus Scheuten

Typhlodromus Scheuten 1857: 111.

Subgenus Anthoseius De Leon

Typhlodromus (Anthoseius) De Leon 1959: 258; van der Merwe 1968: 20; Karg 1982: 194; Chant & McMurtry 1994: 250, 2007: 149.

Typhlodromus (Anthoseius) grewiae Zannou, Moraes & Oliveira

Typhlodromus (Anthoseius) grewiae Zannou, Moraes & Oliveira in Ueckermann et al. 2008: 48.

This species belongs to the singularis species group as setae JV3 are absent and dorsal shield setae are short (Chant and McMurtry 1994). The biology of that species is totally unknown. It was mentioned only from Kenya (Ueckermann et al. 2008) based on single female.

World distribution: Kenya, Mayotte Island.

Specimens examined: A single ♀ specimen collected during this study. Chandra, inside the village (448 m aasl, 12°11’56” S, 44°27’52” E), 1 ♀ on Citrus limon (L.) Burman (Rutaceae), 29/XI/2018.

Remarks: Morphological and morphometric characters of our specimens (Table 5) fit well measurements of the original description by Ueckermann et al. (2008) and with measurements of specimens from Mayotte Island (Kreiter et al. 2020a).

Typhlodromus (Anthoseius) hartlandrowei Evans

Typhlodromus (Typhlodromus) hartlandrowei Evans, 1958: 580-581; Chant 1959: 60. Clavidromus hartlandrowei, Muma, 1961: 296. Typhlodromus (Neoseiulus) hartlandrowei, Pritchard & Baker, 1962: 222. Typhlodromus (Anthoseius) hartlandrowei, Moraes et al., 2004b: 328; Chant & McMurtry, 2007: 155; Ueckermann et al. 2008: 50.

This species belongs to the bergi species group (Chant and McMurtry 1994). The biology of that species is totally unknown. This is the first mention of that species outside the African continent.

World distribution: Democratic Republic of Congo, Nigeria, Uganda.

Specimens examined: two specimens (1 ♀ and 1 ♂) collected during this study. Pomoni, exit of the village (34 m aasl, 12°17’01” S, 44°24’52” E), 1 ♀ and 1 ♂ on Piper nigrum L. (Piperaceae), 30/XI/2018.
Remarks: morphological and morphometric characters of our specimens (Table 6) fit well with those of the original description by Evans (1958), and specimens from Africa studied by Ueckermann et al. (2008).

**Typhlodromus (Anthoseius) lobatus Zannou, Moraes & Oliveira**

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

This species belongs to the rhenanus species group (Chant and McMurtry 1994). Its biology is totally unknown.

**World distribution**: Ghana, Mauritius Island, Mayotte Island, Rodrigues Island.

**Specimens examined**: six specimens (5 ♀♀ and 1 imm.) collected during this study.

**Pomoni**, exit of the village (34 m aasl, 12°17′01″ S, 44°24′52″ E), 1 ♀ on *Cananga odorata* (Lamark) Hooker & Thomson (Annonaceae), 2 ♀♀ and 1 imm. on *Psidium cattleianum* Afzelius ex Sabine (Myrtaceae), 1 ♀ on *Piper nigrum* L. (Piperaceae) and 1 ♀ on *Syzygium jambos* (L.) Alston (Myrtaceae), 30/XI/2018.

Remarks: morphological and morphometric characters of our specimens fit well with those of the original description based on the specimens collected from Ghana, Western Africa by Ueckermann et al. (2008) and with those of specimens from Rodrigues (Kreiter and Abo-Shnaf 2020a), Mauritius (Kreiter and Abo-Shnaf 2020b) and Mayotte (Kreiter et al. 2020a).

**Table 5** Character measurements of adult females of *Typhlodromus (Anthoseius) grewiae* collected in this study compared to those obtained in previous studies (localities followed by the number of specimens measured between brackets).

| Characters | Anjouan Island (1) (this study) | Kenya (1, the holotype) | Mayotte Island (2) |
|------------|---------------------------------|-------------------------|--------------------|
| Dsl        | 315                             | 298                     | 288 – 308          |
| Dsw        | 205                             | 179                     | 168 – 180          |
| j1         | 13                              | Not visible             | 15                 |
| j2         | 20                              | 16                      | 15 – 20            |
| j3         | 15                              | 16                      | 13 – 15            |
| j4         | 15                              | 16                      | 15                 |
| j5         | 20                              | 19                      | 20                 |
| J2         | 10                              | 10                      | 9 – 10             |
| r3         | 18                              | 16                      | 15                 |
| R1         | 18                              | 16                      | 15 – 18            |
| s4         | 20                              | 19                      | 18 – 20            |
| s6         | 25                              | 22                      | 21 – 23            |
| S2         | 30                              | 24                      | 26 – 28            |
| S4         | 30                              | 27                      | 28                 |
| S5         | 25                              | 22                      | 23                 |
| z2         | 18                              | 14                      | 13 – 15            |
| z3         | 18                              | 14                      | 15                 |
| z4         | 20                              | 18                      | 15 – 18            |
| z5         | 19                              | 18                      | 18                 |
| Z4         | 35                              | 29                      | 30 – 33            |
| Z5         | 36                              | 35                      | 33 – 35            |

| Characters | Anjouan Island (1) (this study) | Kenya (1, the holotype) | Mayotte Island (2) |
|------------|---------------------------------|-------------------------|--------------------|
| st1-st1    | 48                              | –                       | 38                 |
| st2-st2    | 60                              | 61 – 63                 |
| st3-st3    | 59                              | –                       | 48                 |
| st4-st4    | 63                              | 58 – 63                 |
| Genst      | 100                             | –                       | 93                 |
| Gensw st5  | 63                              | 53 – 55                 |
| Gensw post. corn. | 68 | – | 75 |
| st5-st5    | 55                              | –                       |
| Lis1       | 20                              | –                       | 18 – 23            |
| Lisw       | 5                               | –                       | 4                  |
| sis1       | 10                              | –                       | 10                 |
| Vsl        | 110                             | 99                      | 95 – 100           |
| Vsw ZV2    | 63                              | 90                      | 83 – 90            |
| Vsw anus   | 70                              | –                       | 68 – 75            |
| gvs3 – gvs3| 25                              | –                       | 26                 |
| JV5        | 26                              | –                       | 25 – 27            |
| StV        | 20                              | 18                      | 17 – 18            |
| Sc1        | 15                              | 14                      | 13 – 15            |
| Scw        | 5                               | –                       | 5                  |
| Fdl        | 25                              | 23                      | 25                 |
| No teeth Fd | Not visible | 3 – 4 | 4 |
| Mdl        | 26                              | 25                      | 25 – 28            |
| No teeth Md | Not visible | 2 | 2 |

**Sources of measurements** – Kenya: Ueckermann et al. (2008), original description based on a single female; Mayotte Island (Kreiter et al. 2020a); – : not provided.
Typhlodromus (Anthoseius) microbullatus von der Merwe

Typhlodromus (Anthoseius) microbullatus von der Merwe 1968: 33; Moraes et al. 2004b: 338; Chant & McMurtry 2007: 155; Ueckermann et al. 2008: 67.

Amblydromella microbullata, Moraes et al. 1986: 167.

Typhlodromus (Anthoseius) microbullatus vanderMerwe1968: 33; Moraes et al. 2004b: 338; Chant&McMurtry2007: 155; Ueckermann et al. 2008: 67.

Amblydromella (Aphanoseia) microbullata, Denmark & Welbourn 2002: 308.

This species also belongs to the rhenanus species group (Chant and McMurtry 1994). It is biology is totally unknown. It was mentioned from Madagascar, Mozambique and South Africa (Ueckermann et al. 2008).

World distribution: Madagascar, Mozambique, South Africa.

Specimens examined: two specimens (2 ♀♀) collected during this study. Dindi, inside the village (567 m aasl, 12°12′56″ S, 44°27′02″ E), 2 ♀♀ on Lantana camara L. (Verbenaceae), 29/XI/2018.

Remarks: Morphological and morphometric characters of our specimens fit well with those of specimens from South Africa in van der Merwe (1968) and Ueckermann et al. (2008) and those of specimens from Mayotte Island (Kreiter et al. 2020a).

Typhlodromus (Anthoseius) moraesii Kreiter & Ueckermann

Typhlodromus (Anthoseius) moraesii Kreiter & Ueckermann in Kreiter et al. 2002: 338.

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

| Characters | Anjouan Island (1) (this study) | Africa (3) | Holotype |
|------------|---------------------------------|------------|----------|
| Dsl        | 325                             | 290 (285 – 295) | 295 |
| Dsw        | 180                             | 206 (200 – 215) | 190 |
| j1         | 20                              | 26 (25 – 27) | – |
| j3         | 38                              | 43 (40 – 45) | 48 |
| j4         | 25                              | 40 (37 – 41) | 44 |
| j5         | 30                              | 40 (36 – 44) | 43 |
| j6         | 33                              | 55 (50 – 59) | 57 |
| J2         | 40                              | 53 (50 – 55) | 56 |
| J5         | 8                               | 10         | 9 |
| v3         | 40                              | 40 (38 – 43) | 44 |
| R1         | 45                              | 59 (58 – 60) | 60 |
| s4         | 58                              | 61 (60 – 62) | 63 |
| s6         | 55                              | 65 (65 – 66) | 67 |
| S2         | 60                              | 69 (68 – 71) | 71 |
| S4         | 65                              | 70 (70 – 71) | 71 |
| S5         | 22                              | 22 (19 – 24) | 17 |
| z2         | 25                              | 24 (23 – 25) | 23 |
| z3         | 45                              | 51 (50 – 51) | 53 |
| z4         | 48                              | 56 (54 – 57) | 58 |
| z5         | 29                              | 38 (35 – 40) | 38 |
| Z4         | 60                              | 63 (62 – 64) | 62 |
| Z5         | 66                              | 64 (63 – 66) | 63 |

Sources of measurements – Africa (DR Congo 1♀, Nigeria 1♀, Uganda 1♀) & Holotype: Ueckermann et al. (2008); – : not provided.

Table 6 Character measurements of adult females of Typhlodromus (Anthoseius) hartlandrowei collected in this study compared to those in previous studies (localities followed by the number of specimens measured between brackets).
World distribution: La Réunion Island.

Specimens examined: a single ♀ specimen collected during this study. Pomoni, exit of the village (34 m aasl, 12°17′01″ S, 44°24′52″ E), 1 ♀ on Cymbopogon citratus (De Candolle) Stapf (Poaceae), 30/XI/2018.

Remarks: several species are found both in La Réunion Island (in the Indian Ocean) and in the West Indies, probably because of reciprocal introductions certainly long time ago with slaves 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 characteristics of the specimens collected fit very well with those given by Kreiter et al. (2002) and with measurements of specimens from Rodrigues Island (Kreiter and Abo-Shnaf 2020a).

Typhlodromus (Anthoseius) transvaalensis (Nesbitt)

Kampimodromus transvaalensis Nesbitt 1951: 55.

Neoseiulus transvaalensis, Muma 1961: 295.

Clavidiromus transvaalensis, Muma & Denmark 1968: 238, 1970: 128; Moraes et al. 1986: 182.

Typhlodromus transvaalensis, Chant & Baker 1965: 5; Schicha 1981a: 36; Moraes et al. 2004b: 355; Chant & McMurtry 1994: 252, 2007: 157.

Typhlodromus jacknickleyi, De Leon 1958: 75; van Der Merwe 1968: 23 (synonymy according to Muma & Denmark 1968).

Typhlodromus pectinatus, Athias-Henriot 1958: 179 (synonymy according to Muma & Denmark 1968).

This species has elongate serrated dorsal setae, setae Z1 and JV3 absent, an elongate calyx of the spermatheca, leg IV with 3 macrosetae and few teeth on chelicerae. It belongs to the transvaalensis species group of the subgenus Anthoseius of the genus Typhlodromus (Chant and McMurtry 1994).

According to McMurtry et al. (2013), T. (A.) transvaalensis is a type III phytoseiid and a generalist predator that feeds on mites, insects and pollen. It completed its life cycle when fed on the eriophid mites Eriophyes dioscoridis Soliman and Abo-Awad and Eriophyes olive Zaher and Abo-Awad, eggs of the scale insect Parlatoria zizyphus (Lucas) and pollen of Ricinus communis L. in experimental conditions. The percentage of individuals attaining maturity was less than 20% when nymphs of the tetranychid mite, T. urticae Koch, were provided. The development was faster and reproduction was higher when T. (A.) transvaalensis fed on eriophid mites. T. urticae was an unsuitable feeding for reproduction of the phytoseiid. The daily reproduction was as low as 0.4 and 0.8 egg/female/day when females were maintained on pollen grains of R. communis and eggs of P. zizyphus. The adult female daily consumed 126, 97 and 6 individuals of E. olivi, E. dioscoridis and T. urticae, respectively (Momen and Hussein 1999). Adult female T. (A.) transvaalensis were more efficient at predating all stages of P. latus (Banks) than Tetramychus bastosi Tuttle, Baker and Sales. The T. (A.) transvaalensis life cycle was shorter with diets including R. communis pollen, but Zea mays L. pollen was also suitable for reproduction. The results indicate that T. (A.) transvaalensis is a generalist predator with high potential for controlling P. latus in Jatropha curcas L. plantations and that the presence of R. communis and Z. mays crops boosts its development and reproduction (Cañarte et al. 2017).

This species is widely distributed all over the world (Demite et al. 2020). It was recorded from La Réunion Island in the Indian Ocean (Quilici et al. 2000, Kreiter et al. 2020d).

Specimens examined: 25 specimens (13 ♀♀, 9 ♂♂ and 3 imm.) collected during this study. Chandra, inside the village (448 m aasl, 12°11′56″ S, 44°27′52″ E), 1 ♀ on Vitis vinifera L. (Vitaceae), 29/XI/2018; Pomoni, exit of the village (34 m aasl, 12°17′01″ S, 44°24′52″ E), 11 ♀, 9 ♂♂ and 1 imm. on Mangifera indica L. (Anacardiaceae), 2 imm. on Syzygium aromaticum (L.) Merrill and Perry (Myrtaceae) and 1 ♀ on Hibiscus tiliaceus L. (Malvaceae), 30/XI/2018.
Remarks: all measurement values fit well those already published for this species with only very slight variations. Measurement values of female specimens of Anjouan are very similar with values for specimens from La Réunion (Kreiter et al. 2020d), Kenya and South Africa (Ueckermann et al. 2008).

Conclusion

The result of a survey conducted in 2018 in Anjouan Island is presented in this paper. A total of 18 species belonging to three subfamilies: Amblyseiinae (9), Phytoseiinae (2) and Typhlodrominae (7) are reported for the first time in the island. These species are Neoseiulus lula, Paraphytoseius hrrifer, Amblyseius duplicesetus, A. herbicolus, A. laroensis, A. parasundi, Euseius hima, Typhlodromalus spinosus, Ueckermannseius eastafricae, Phytoseius amba, P. crinitus, Chanteius contiguus, Typhlodromus (Anthoseius) grewiae, T. (A.) hartlandrowei, T. (A.) lobatus, T. (A.) microbullatus, T. (A.) moraesi, T. (A.) transvaalensis.

Among the 18 recorded species, at least four species [A. laroensis, A. herbicolus, T. spinosus and T. (A.) transvaalensis] are already known as biological control agents. In addition to the intrinsic value of phytoseiid mite biodiversity in tropical environments, demonstration of the natural occurrence of efficient BCAs in a developing country such as Comoros is of great agricultural, commercial and strategic interests for the country.

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