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

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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 Nzwani 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; **Mdl** = 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 spermatodactyl; **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* Swirskii & 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) (this study)	**Africa** (3)	**Central Africa** (1)	**Holotype Congo**	**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
z2	**18**	20(19 – 21)	19	19	18	21	19
z4	**19**	21 (20 – 22)	19	20	20	21	17
z5	**15**	16 (15 – 16)	15	16	15	16	14
Z1	**18**	21 (19 – 22)	20	24	19	24	20
Z4	**29**	35 (30 – 43)	25	35	28	34	27
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
Scl	**3**	5	2	–	3	5	–
Scw	**10**	11 (11 – 12)	12	–	12	14	–
Fdl	**30**	32	35	–	38	–	–
No teeth Fd	**7**	8	–	–	8	06-juil	–
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 duplicesetus Moraes & McMurtry

Amblyseius duplicesetus 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 duplicesetus 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 aasl, 12°12′27″ S, 44°27′54″ E), 1 ♀ on *Mangifera indica* L. (Anacardiaceae), 29/XI/2018; **Chandra**, inside the village (448 m aasl, 12°11′56″ S, 44°27′52″ E), 2 ♀♀ and 1 ♂ on *Acalypha wilkesiana* Müller Argoviensis (Euphorbiaceae), 29/XI/2018; **Pomoni**, exit of the village (34 m aasl, 12°17′01″ S, 44°24′52″ E), 2 ♀♀ and 1 ♂ on *Artocarpus heterophyllus* Lamarck (Moraceae), 1 ♀ and 1 ♂ on *Artocarpus altilis* (Parkinson) Fosberg (Moraceae), 1 ♀ on *Theobroma cacao* L. (Malvaceae), 2 ♀♀ on *Sygygium 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 McMurtry 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 duplicesetus* collected in this study with those obtained from previous studies (localities followed by the number of specimens measured between brackets).

Characters	Anjouan (13) (this study)	Kenya 1 (2)	Kenya 2 (1)	Kenya 3 (1?)	Sri Lanka (3)
Dsl	**349 (328 – 363)**	360	384	335	352 (335 – 368)
Dsw	**226 (200 – 243)**	240	259	196	242 (225 – 257)
j1	**38 (34 – 40)**	42 (41 – 43)	43	46	39 (36 – 42)
j3	**47 (43 – 49)**	47 (43 – 51)	54	50	46 (43 – 50)
j4	**8 (8 – 10)**	8 (7 – 10)	6	4 – 6	7 (7 – 8)
j5	**6 (5 – 8)**	8 (7 – 10)	6	4 – 6	6
j6	**8 (5 – 9)**	8 (7 – 10)	8	4 – 6	7 (7 – 8)
J2	**9 (8 – 10)**	11 (10-12)	11	4 – 6	10
J5	**10 (8 – 12)**	11 (10-12)	8	4 – 6	9
r3	**12 (10 – 15)**	12	11	10	15 (15 – 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)
z2	**10 (8 – 12)**	8	8	4 – 6	12
z4	**10 (9 – 11)**	11 (10 – 12)	10	4 – 6	9
z5	**7 (5 – 8)**	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)**	323 (310 – 336)	330	304	300 (290 – 308)
st1-st1	**60 (54 – 65)**	–	–	–	–
st2-st2	**69 (63 – 73)**	67	74	70	66 (65 – 67)
st3-st3	**70 (63 – 73)**	–	–	–	–
st1-st3	**67 (64 – 70)**	62	66	55	64 (62 – 66)
st4-st4	**70 (55 – 85)**	–	–	–	–
Gensl	**123 (115 – 133)**	–	–	–	–
Gensw *st5*	**74 (65 – 85)**	–	–	–	–

Characters	Anjouan (13) (this study)	Kenya 1 (2)	Kenya 2 (1)	Kenya 3 (1?)	Sri Lanka (3)
Gensw post. corn.	**73 (63 – 88)**	–	–	–	–
st5-st5	**68 (60 – 80)**	70 65 – 75)	70	74	68 (67 – 68)
Lisl	**24 (20 – 28)**	–	–	–	–
Lisw	**5 (4 – 5)**	–	–	–	–
Sisl	**10 (8 – 13)**	–	–	–	–
Vsl	**107 (93 – 113)**	115 (113 – 117)	128	115	109 (107 – 110)
Vsw *ZV2*	**56 (50 – 62)**	54 (53 – 55)	56	55	56 (54 – 57)
Vsw *anus*	**65 (53 – 70)**	66 (65 – 67)	67	70	63 (60 – 66)
gv3 – gv3	**29 (24 – 32)**	–	–	–	–
JV5	**58 (49 – 68)**	–	–	60	–
SgeI	**47 (43 – 50)**	50 (48 – 52)	50	–	46 (45 – 47)
StiI	**30**	–	–	–	30 (28 – 34)
SgeII	**39 (37 – 42)**	38	40	36	42 (38 – 46)
StiII	**29**	–	–	–	30
SgeIII	**49 (45 – 54)**	47 (43 – 51)	53	48	48 (48 – 49)
StiIII	**40 (35 – 46)**	37 (34 – 41)	46	36	43 (40 – 46)
StIII	**30**	–	–	–	–
SgeIV	**161 (150 – 170)**	157 (156 – 158)	166	145	154 (144 – 163)
StiIV	**115 (93 – 123)**	116 (112 – 120)	118	106	113 (98 – 120)
StIV	**63 (60 – 68)**	68 (67 – 69)	74	65	74 (72 – 76)
Scl	**15 (12 – 20)**	12	16	12	11 (10 – 12)
Scw	**9 (5 – 12)**	–	–	–	–
Fdl	**29 (26 – 30)**	29	29	–	32 (32 – 33)
No teeth Fd	**12**	13	12	12	–
Mdl	**31 (30 – 39)**	31	31	–	34 (34 – 35)
No teeth Md	**3**	3	3	3	–

Sources of measurements – Kenya 1: Moraes & McMurtry (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.
Amblyseius impactus Chaudhri 1968: 553 (synonymy according to Daneshvar & Denmark 1982).
Typhlodromus (*Amblyseius*) *amitae* Bhattacharyya 1968: 677 (synonymy according to Denmark & Muma 1989).
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 ventrianal 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

Table 3 Character measurements of adult males of *Amblyseius duplicesetus* collected in this study with those obtained from previous studies (localities followed by the number of specimens measured between brackets).

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)**	–

Characters	**Anjouan** (5)	**Kenya** (1)
Vsl	**113 (110 – 118)**	122
Vsw *ZV2*	**147 (138 – 158)**	160
Vsw *anus*	**55 (50 – 60)**	–
gv3 – gv3	**23 (20 – 25)**	–
JV5	**39 (34 – 45)**	–
SgeI	**36 (34 – 40)**	–
StiI	**30**	
SgeII	**31 (30 – 33)**	–
StiII	**25**	
SgeIII	**38 (37 – 38)**	–
StiIII	**33 (32 – 33)**	–
StIII	**28**	–
SgeIV	**95 (93 – 98)**	–
StiIV	**74 (70 – 78)**	–
StIV	**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 (*Amblyseialus*) *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 amtalaensis 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* *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/XI/2018; **Pomoni**, exit of the village (34 m aasl, 12°17′01″ S, 44°24′52″ E), 1 ♀ on *Sygygium 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.* 2010; 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

Ueckermannseius eastafricae Moraes *et al.* 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

Phytoseius (*Pennaseius*) *amba* Pritchard & Baker 1962: 224; Blommers 1976: 85;
Phytoseius (*Phytoseius*) *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

Table 4 Character measurements of adult females of *Ueckermannseius eastafricae* collected in this study with those obtained from previous studies (localities followed by the number of specimens measured between brackets).

Characters	Anjouan (2) (this study)	Africa (7)
Dsl	**333 – 338**	390 (336 – 405)
Dsw	**170 – 195**	274 (258 – 291)
j1	**34 – 35**	34 (30 – 38)
j3	**22 – 24**	23 (19 – 27)
j4	**8 – 10**	15 (11 – 18)
j5	**8 – 10**	14 (10 – 19)
j6	**9 – 11**	12 (10 – 16)
J2	**12 – 13**	13 (10 – 16)
J5	**6 – 7**	5 (3 – 6)
r3	**15 – 18**	18 (16 – 21)
R1	**13**	18 (14 – 21)
s4	**21 – 23**	26 (19 – 35)
S2	**13 – 15**	18 (16 – 22)
S4	**13 – 15**	17 (14 – 21)
S5	**13 – 15**	16 (14 – 21)
z2	**13 – 15**	20 (16 – 24)
z4	**13 – 15**	21 (13 – 29)
z5	**10**	14 (13 – 16)
Z1	**11 – 13**	16 (13 – 21)
Z4	**13 – 14**	16 (11 – 19)
Z5	**43**	39 (32 – 53)
st1-st1	**55**	–
st2-st2	**63 – 65**	72 (69 – 80)
st3-st3	**75**	–
st1-st3	**63 – 65**	71 (62 – 77)
st4-st4	**75 – 81**	–

Characters	Anjouan (2) (this study)	Africa (7)
Gensl	**128 – 138**	–
Gensw *st5*	**80**	–
Gensw post. corn.	**80 – 85**	–
st5-st5	**75 – 81**	80 (67 – 90)
Lisl	**28**	–
Lisw	**2 – 4**	–
Sisl	**Not visible**	–
Vsl	**90 – 95**	122 (96 – 130)
Vsw *ZV2*	**60**	78 (67 – 85)
Vsw *anus*	**65 – 75**	71 (62 – 75)
JV5	**28 – 30**	–
SgeI	**20 – 23**	–
SgeII	**22 – 23**	28 (24 – 34)
SgeIII	**31 – 33**	39 (37 – 45)
StiIII	**28 – 30**	31 (29 – 37)
SgeIV	**43 – 53**	57 (51 – 62)
StiIV	**40 – 45**	44 (34 – 56)
StIV	**70**	58 (51 – 69)
Scl	**30 – 37**	35
Scw	**11 – 14**	–
Fdl	**25 – 26**	34 (33 – 35)
Nb teeth Fd	**Not visible**	10
Mdl	**23 – 28**	38
Nb teeth Md	**Not visible**	4

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 *Sygygium 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 *Sygygium jambos* (L.) Alston (Myrtaceae), 30/XI/2018.

Remarks: morphological and morphometric characters 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 *Sygygium 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
j3	**20**	16	15 – 20
j4	**15**	16	13 – 15
j5	**15**	16	15
j6	**20**	19	20
J2	**25**	22	21 – 23
J5	**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	53
st3-st3	**59**	–	48
st1-st3	**63**	58	55
st4-st4	**63**	–	43
Gensl	**100**	–	93
Gensw *st5*	**63**	53	50
Gensw post. corn.	**68**	–	75
st5-st5	**55**	–	–
Lisl	**20**	–	18 – 23
Lisw	**5**	–	4
sisl	**10**	–	10
Vsl	**110**	99	95 – 100
Vsw *ZV2*	**63**	90	83 – 90
Vsw anus	**70**	–	68 – 75
gv3 – gv3	**25**	–	26
JV5	**26**	–	25 – 27
StIV	**20**	18	17 – 18
Scl	**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 base on a single female; **Mayotte Island** (Kreiter *et al.* 2020a); – : not provided.

Typhlodromus (*Anthoseius*) *microbullatus* van der Merwe

Typhlodromus (*Anthoseius*) *microbullatus* van 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.
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*) *moraesi* Kreiter & Ueckermann

Typhlodromus (*Anthoseius*) *moraesi* 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.

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).

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
r3	**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

Characters	Anjouan Island (1) (this study)	Africa (3)	Holotype
st1-st1	**50**	–	–
st2-st2	**53**	55 (54 – 56)	50
st3-st3	**65**	–	–
st1-st3	**55**	55 (52 – 57)	59
st4-st4	**70**	–	–
Gensl	**110**	–	–
Gensw *st5*	**Not visible**	55 (53 – 57)	55
Gensw post. corn.	**Not visible**	–	–
Lisl	**30**	–	–
Lisw	**4**	–	–
sisl	**11**	–	–
Vsl	**100**	102 (98 – 104)	97
Vsw *ZV2*	**90**	89 (84 – 96)	85
Vsw anus	**68**	–	–
JV5	**63**	–	–
SgeIII	**19**	22 (21 – 22)	20
StiIII	**18**	18 (17 – 19)	19
SgeIV	**29**	32 (31 – 32)	32
StiIV	**22**	22 (21 – 24)	23
StIV	**45**	40 (37 – 42)	43
Scl	**10**	14 (11 – 17)	–
Scw	**8**	–	–
Fdl	**23**	24	–
No teeth Fd	**Not visible**	2	–
Mdl	**26**	27	–
No teeth Md	**Not visible**	1	–

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

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.
Clavidromus 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 jackmickleyi, 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 eriophyid mites *Eriophyes dioscoridis* Soliman and Abou-Awad and *Eriophyes olive* Zaher and Abou-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 eriophyid 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 *Tetranychus 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 *Sygygium 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 horrifer, Amblyseius duplicesetus, A. herbicolus, A. largoensis, 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. largoensis, 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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