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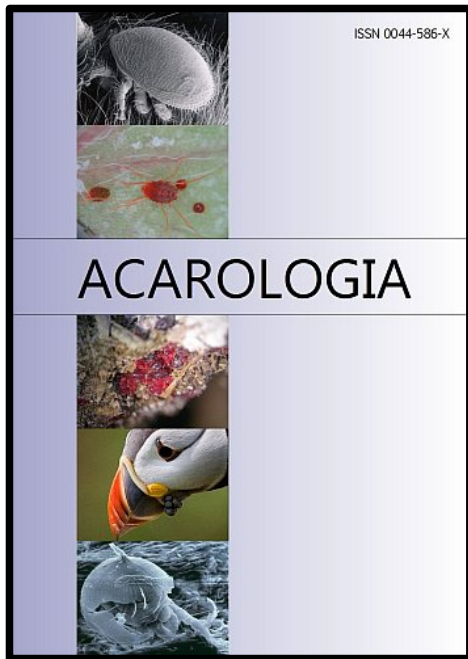
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Two new records of the genus *Kampimodromus* Nesbitt (Acari: Phytoseiidae) for Turkey with a revised key to the World species

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ABSTRACT — Two species of the genus *Kampimodromus* Nesbitt, *K. keae* (Papadoulis and Emmanouel) and *K. ragusai* Swirski and Amitai are reported for the first time in Turkey. The new records are re-described and illustrated. The male *K. ragusai* is described for the first time. The species status of *K. keae* and *K. ragusai* as valid species within the genus *Kampimodromus* is discussed. A revised key to all known species of *Kampimodromus* is provided.

KEYWORDS — *Kampimodromus*; re-description; movable digit dentition; peritreme length; identification key

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INTRODUCTION

There are 15 nominal species in the genus *Kampimodromus* Nesbitt, 1951 (Acari: Phytoseiidae) belonging to the sub-family Amblyseiinae (Acari: Mesostigmata). They are characterized by having dorsal setal pattern 10A:8C with 18 pairs of dorsal setae (*S4* absent) including sub-laterals *r3* and *R1* (Chant and McMurtry, 2003). All *Kampimodromus* species were described from the Western Palearctic region except for *K. alettae* (Ueckermann and Loots) and *K. molle* (Ueckermann and Loots) which are known from South Africa (Ueckermann and Loots, 1985). Chant and McMurtry, (2003) postulated that the genus *Kampimodromus* evolved in the Mediterranean region and spread to other parts of the world from there. *Kampimodromus aberrans* (Oudemans, 1930) is the most widely distributed species recorded from almost all over Western Palearctic

countries and the USA (Demite *et al.*, 2016). However, it is doubtful if all recorded specimens are really *K. aberrans*.

In this study, *K. keae* (Papadoulis and Emmanouel, 1991) and *K. ragusai* Swirski and Amitai, (1997) are re-discovered for the first time after their original descriptions (Papadoulis and Emmanouel 1991; Swirski and Amitai 1997). The unknown male of *K. ragusai* is described and illustrated for the first time. In addition, an identification key for all known species of the genus *Kampimodromus* is given.

MATERIALS AND METHODS

Leaf samples were wrapped in paper towel and placed in plastic bags and the latter in an icebox. The samples were examined under stereobinocular and phytoseiid mites mounted in Hoyer's medium

on microscope slides. An Olympus® U-DA drawing tube, was used for the illustrations. The taxonomic system is based on that proposed by Chant and McMurtry, (2007). The setal nomenclature used follow Lindquist and Evans, (1965) as adapted by Rowell *et al.*, (1978). For the organotaxy, Athias-Henriot, (1975; 1977) was followed; for the ventral pores and leg chaetotaxy Evans, (1963) and Evans and Till, (1979); and Wainstein, (1973) for the spermatheca. The dorsal and ventral setal pattern notations follow Chant and Yoshida-Shaul, (1989; 1991; 1992). All measurements are given in micrometers (µm) and presented as the mean followed by the range in parenthesis.

RESULTS

Kampimodromus keae (Papadoulis and Emmanouel) (Figure 1)

Amblyseius keae Papadoulis and Emmanouel, 1991: 265.

Kampimodromus keae (Papadoulis and Emmanouel), Chant and McMurtry, 2003: 196; Tixier *et al.*, 2003: 356; 2008: 133; Ragusa Di Chiara and Tsolakis, 1994: 312; Papadoulis *et al.* 2009: 45.

Female (Fig. 1) (n=1)

Dorsum (Fig. 1A) — Dorsal setal pattern 10A:8C (*r3* and *R1* off shield). Dorsal shield oval with waist, sclerotized, with a few striations posterolaterally and reticulated area between setae *j6* and *Z4*. Bearing four pairs of solenostomes (*gd1*, *gd2*, *gd6* and *gd9*); *gd1* and *gd9* rounded, *gd2* prominent, *gd6* crescentic; muscle-marks (sigilla) visible on podosoma, length of dorsal shield (*j1*-*J5*) 280, width (distance between bases of *s4*) 118 (distance between bases of *S2*) 133. Setae, *j4*, *j5*, *j6*, *J2*, *J5*, *z5*, and *Z1* are smooth, others are serrated. Measurements of dorsal setae as follows: *j1* 15, *j3* 28, *j4* 15, *j5* 15, *j6* 18, *J2* 20, *J5* 5, *z2* 28, *z4* 28, *z5* 15, *Z1* 20, *Z4* 30, *Z5* 40, *s4* 33, *S2* 33, *S5* 23, *r3* 30 and *R1* 23.

Peritreme — Extending to level of setae *z4*.

Venter (Fig. 1B) — Ventral setal pattern 14:JV-3:ZV. Sternal shield smooth, lightly sclerotized, with three pairs of setae (*ST1*, *ST2* and *ST2*) and two

pairs of pores (*pst1* and *pst2*); length (*ST1*-*ST3*) 49, width (distance between bases of *ST2*) 46; metasternal setae *ST4* and a pair of pores (*pst3*) on metasternal shields. Genital shield smooth; width at level of genital setae (*ST5*) 43. Ventrianal shield elongate with waist at level of *JV2*; with a few striations; bearing three pairs of pre-anal setae (*JV1*, *JV2* and *ZV2*), a pair of para-anal (*Pa*) and a post-anal seta (*Pst*); a pair of small pores (*gv3*) posterior to *JV2* (distance between the *gv3* pores 20) and muscle-marks posterolaterally. Length of ventrianal shield 88, width 48. Setae *JV4*, *JV5*, *ZV1*, *ZV3*, and eight pairs of pores on integument surrounding ventrianal shield. Setae *JV5* serrated, much longer than other ventral setae, 25 in length.

Chelicera (Fig. 1C) — Fixed digit 25 long with two apical teeth and *pilus dentilis*; movable digit 25 long with one tooth.

Spermatheca (Fig. 1D) — Calyx cup-shaped 5 in length; with atrium small nodular, major duct long, minor duct not visible.

Legs (Fig. 1E) — Length of legs (base of coxae to base of claws) as follows: leg I 230, leg II 195, leg III 185, leg IV 245. Genu II, III, and IV with eight, seven and eight setae, respectively. Leg IV with one pointed macrosetae, *StIV* 15.

Material examined — One female, 16 June 2016, Kadincik Valley National Park, Mersin Province on *Quercus* sp. (Fagaceae).

World Distribution — Greece (Papadoulis and Emmanouel 1991; Papadoulis *et al.*, 2009) and Turkey (this study).

Remarks — *Kampimodromus keae* is a new record for Turkish fauna. Turkish specimen well fit original description and re-descriptions of *K. keae* (Papadoulis and Emmanouel, 1991; Ragusa Di Chiara and Tsolakis, 1994; Papadoulis *et al.*, 2009). However, the length of setae *Z5* and *r3* in the type material are, 34 and 36 oppose to 40 and 30 in Turkish specimen, respectively. According to Tixier *et al.*, (2003), *K. keae* is suspected to be junior synonym of *K. aberrans* as they only differ, in the presence and absence of a tooth on movable digit (MD) of the chelicera, respectively (Tixier *et al.*, 2003; Chant and McMurtry, 2003). *Kampimodromus ragusai* and

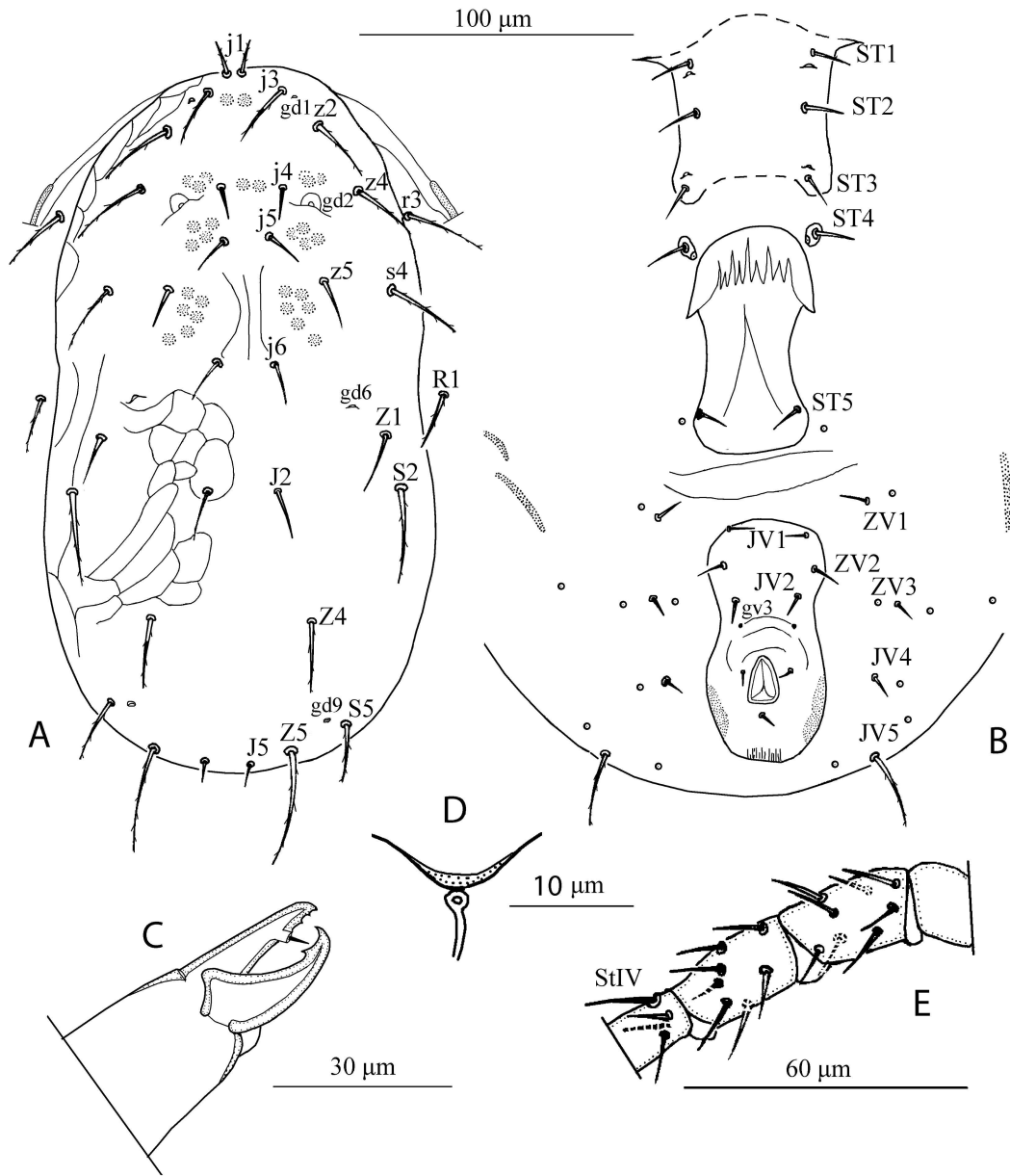


FIGURE 1: *Kampimodromus keae* (Papadoulis and Emmanouel) (Female): A – Dorsal shield; B – Ventral idiosoma; C – Chelicera; D – Spermathecae; E – Leg IV.

K. keae are also grouped together in an identification key provided by Tixier *et al.*, (2008). However, it should be noted that *K. keae* has shorter peritremes compared to both *K. aberrans* and *K. ragusai* (Papadoulis and Emmanouel, 1991; Ragusa Di Chiara and Tsolakis, 1994). According to our three years collection, *K. ragusai* was never found together with neither *K. keae* nor any other phytoseiid species (see collection details of *K. ragusai*). But, *K. keae* was found together with a large population of *Typhloseiulus peculiaris* (Kolodochka, 1980) on *Quercus* sp. As the peritreme length did not vary in the examined specimens of *K. ragusai*, we consider them as two distinct species. But, nothing is known whether peritreme length is a reliable character for separation of species in the genus *Kampimodromus*. Therefore, it should be validated by molecular studies.

Kampimodromus ragusai
Swirski and Amitai
(Figure 2)

Kampimodromus ragusai Swirski and Amitai, 1997: 3; Swirski *et al.*, 1998: 108; Chant and McMurtry, 2003: 196; Tixier *et al.*, 2003: 356; 2008: 133.

Female (Fig. 2) (n=10)

Dorsum (Fig. 2A) — Dorsal setal pattern 10A:8C (*r3* and *R1* off shield). Dorsal shield oval with waist, sclerotized, with a few striations, bearing four pairs of solenostomes (*gd1*, *gd2*, *gd6* and *gd9*); first three are crescentic and *gd9* is rounded; muscle-marks (sigilla) visible, mostly on podosoma, length of dorsal shield (*j1-j5*) 290 (288 – 293), width (distance between bases of *s4*) 119 (118 – 120) (distance between bases of *S2*) 129 (128 – 130). Setae, *j4*, *j5*, *j6*, *J2*, *J5*, *z5*, and *Z1* are smooth, others are serrated. Measurements of dorsal setae as follows: *j1* 19 (18 – 20), *j3* 29 (28 – 30), *j4* 14 (13 – 15), *j5* 14 (13 – 15), *j6* 14 (13 – 15), *J2* 21 (20 – 23), *J5* 5, *z2* 31 (30 – 33), *z4* 30 (28 – 33), *z5* 14 (14 – 15), *Z1* 19 (18 – 20), *Z4* 41 (40 – 43), *Z5* 49 (48 – 50), *s4* 34 (33 – 35), *S2* 39 (38 – 40), *S5* 21 (20 – 23), *r3* 36 (35 – 38) and *R1* 26 (25 – 28).

Peritreme — Extending to level of setae *z2*.

Venter (Fig. 2B) — Ventral setal pattern 14:JV – 3:ZV. Sternal shield smooth, lightly sclerotized, with three pairs of setae (*ST1*, *ST2* and *ST2*) and

two pairs of pores (*pst1* and *pst2*); length (*ST1-ST3*) 51 (50 – 53), width (distance between bases of *ST2*) 54 (53 – 55); metasternal setae *ST4* and a pair of pores (*pst3*) on metasternal shields. Genital shield smooth; width at level of genital setae (*ST5*) 46 (45 – 48). Ventrianal shield elongate with waist at level of *JV2*; with a few striations; bearing three pairs of pre-anal setae (*JV1*, *JV2* and *ZV2*), a pair of para-anal (*Pa*) and a post-anal setae (*Pst*); a pair of small pores (*gv3*) posterior to *JV2* (distance between the *gv3* pores 29) and muscle-marks posterolaterally. Length of ventrianal shield 91 (90 – 93), width 51 (50 – 53). Setae *JV4*, *JV5*, *ZV1*, *ZV3*, and eight pairs of pores on integument surrounding ventrianal shield. Setae *JV5* serrated, much longer than other ventral setae, 31 (30 – 33) in length.

Chelicera (Fig. 2C) — Fixed digit 23 (22 – 25) long with two apical teeth and *pilus dentilis*; movable digit 24 (24 – 25) long with one tooth.

Spermatheca (Fig. 2D) — Calyx cup-shaped 6 (5 – 8) in length; with atrium small nodular, major duct long, minor duct not visible.

Legs (Fig. 2E) — Length of legs (base of coxae to base of claws) as follows: leg I 236 (235 – 238), leg II 191 (190 – 193), leg III 184 (183 – 185), leg IV 244 (243 – 245). Genu II, III, and IV with eight, seven and eight setae, respectively. Leg IV with one pointed macrosetae, *StIV* 19 (18 – 20).

Male (Fig. 2) (n=5) Similar to female. But, dorsal shield is slightly reticulated.

Dorsum — Dorsal setal pattern 10A:8C (*r3* off shield, *R1* on shield). Dorsal shield oval, sclerotized, reticulated, bearing four pairs of solenostomes (*gd1*, *gd2*, *gd6* and *gd9*); all pores prominent; *gd2* is the largest. Length of dorsal shield (*j1-j5*) 209 (208 – 210), width (distance between bases of *s4*) 99 (98 – 100) and (distance between bases of *S2*) 101 (100 – 103). Serrations of the setae as in female. Measurements of dorsal setae as follows: *j1* 16 (15 – 18), *j3* 37 (36 – 39), *j4* 20 (19 – 21), *j5* 22 (21 – 24), *j6* 24 (23 – 25), *J2* 32 (30 – 33), *J5* 7 (5 – 8), *z2* 35 (34 – 36), *z4* 40 (39 – 42), *z5* 22 (21 – 23), *Z1* 32 (31 – 33), *Z4* 37 (36 – 38), *Z5* 39 (38 – 40), *s4* 44 (43 – 45), *S2* 42 (40 – 43), *S5* 16 (15 – 18), *r3* 36 (35 – 38) and *R1* 26 (25 – 28).

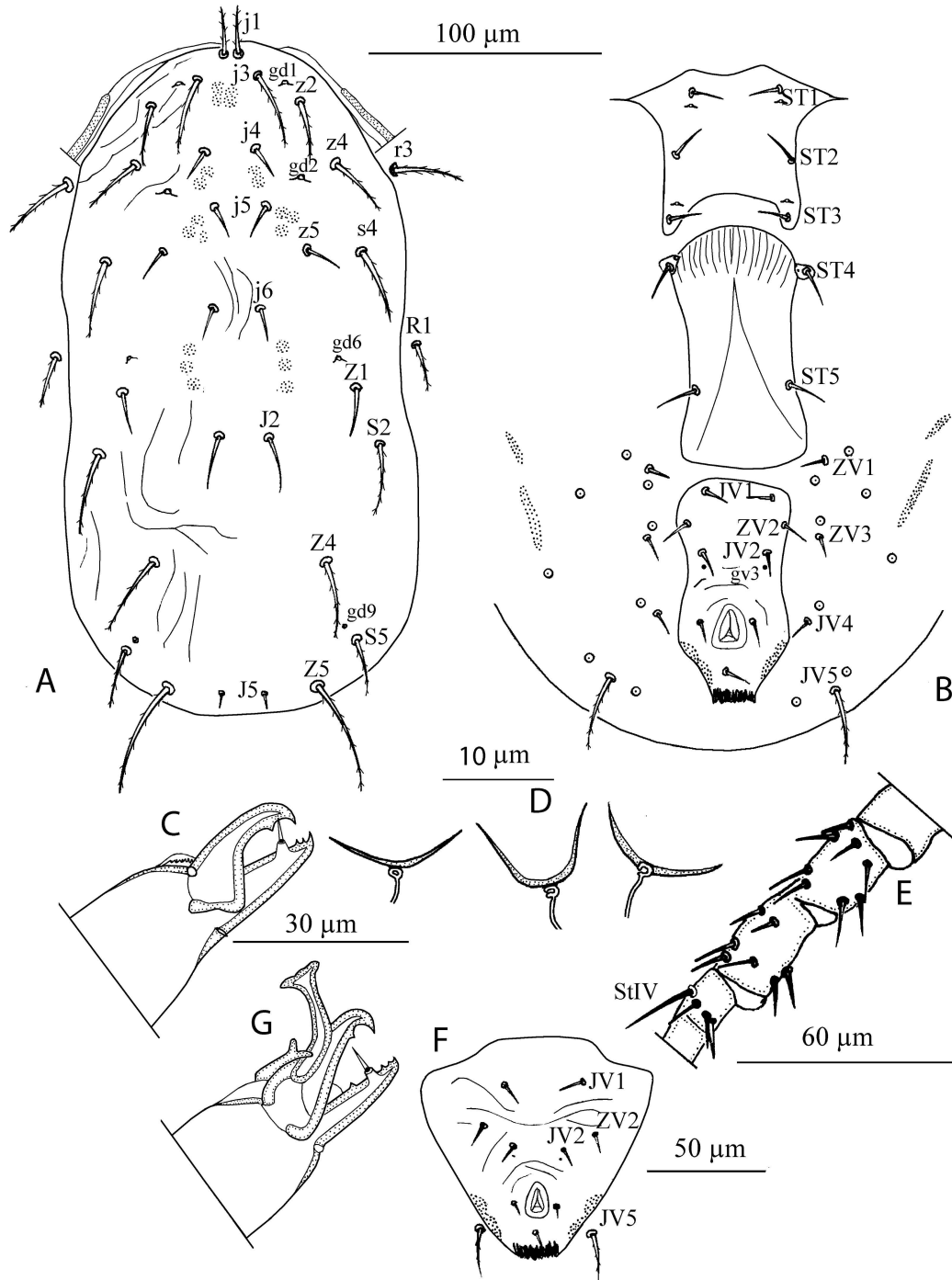


FIGURE 2: *Kampinodromus ragusai* Swirski and Amitai, (Female): A – Dorsal shield; B – Ventral idiosoma; C – Chelicera; D – Spermathecae; E – Leg IV. (Male); F – Ventrianal shield; G – Chelicera.

Peritreme — Extending to level of setae z2.

Venter (Fig. 2F) — Ventral setal pattern 11:JV – 3,4: ZV – 1,3. Sternogenital shield smooth, lightly sclerotized, with five pairs of setae (*ST1*, *ST2*, *ST3*, *ST4* and *ST5*) and three pairs of crescentic pores. Ventrianal shield triangular, with striations, bearing three pairs of pre-anal setae (*JV1*, *JV2* and *ZV2*), a pair of para-anal (*Pa*) and a post-anal setae (*Pst*); a pair of small pores (*gv3*) is present posterior to *JV2*; muscle-marks, posterolaterally. Length of ventrianal shield 89 (86 – 90), width 100 (99 – 103). Setae *JV5* serrated, much longer than other ventral setae, 19 (20 – 21) in length.

Chelicera (Fig. 2G) — Fixed digit with three teeth and *pilus dentilis*; two apically and the other behind *pilus dentilis*; movable digit with one tooth, spermatodactyl with a strong toe and an opposing heel. Foot 15 (14 – 16) long, (from basal attachment point to tip of toe).

Legs — Genu II, III, and IV with eight, seven and eight setae, respectively. Leg IV with one pointed macroseta, *StIV* 19 (18 – 20).

Material examined — 35 females and one male, 2 November 2014; 18 females and one male, 10 October 2015 associated with tydeid mites (Acari: Tydeidae); 21 females and two males, 17 March 2016; 10 females and one male 7 June 2016, associated with tydeid and tetranychid mites *Tetranychus* sp. (Acari: Tetranychidae), near Sunturas waterfall, Hangedigi town, Mersin Province on *Quercus cerris* (Fagaceae).

World Distribution — Israel (Swirski and Amitai, 1997) and Turkey (this study).

Remarks — *Kampimodromus ragusai* is a new record for Turkish fauna. The male *K. ragusai* is described for the first time in this study. Based on female, Turkish specimens well fit original description of *K. ragusai* given by Swirski and Amitai, (1997). However, the length of setae *Z4*, *Z5* and *S5* in the type material are 30, 38 and 13 oppose to 41, 49 and 21 in Turkish specimens, respectively. As in *K. keae* the only difference between *K. ragusai* and *K. aberrans* is also the presence and absence of a tooth on MD of the chelicera, respectively, therefore former was suspected to be junior synonym of the latter (Tixier *et al.*, 2003; Chant and McMurtry, 2003).

However, as suggested by Tixier *et al.*, (2008), MD dentition is a reliable character for discrimination between *Kampimodromus* species that have similar numbers of solenostomes on the dorsal shield. In addition, all 84 females of the Turkish specimens of *K. ragusai* have one tooth on MD. These two species further differ in that the fixed digit (FD) of the male of *K. aberrans* bears two apical teeth (Ragusa Di Chiara and Tsolakis, 1994; Arutunjan, 1977) while that of the male of *K. ragusai* bears three teeth (two apically and the other behind the *pilus dentilis*). Therefore, we consider the presence of a tooth on MD of the female and presence of an additional tooth behind *pilus dentilis* on FD of the male *K. ragusai* as reliable characters to separate it from *K. aberrans*. Swirski and Amitai, (1997) reported that Genu II and IV each have eight setae, rarely seven setae. All the female Turkish specimens have eight setae on genu II and IV.

NOTES ON IDENTIFICATION KEY

Ragusa Di Chiara and Tsolakis, (1994) provided first identification key for the genus *Kampimodromus* with eight species that were known at that time. Tixier *et al.* (2008) provided second key after confirming that movable digit dentition is a useful character. In addition to the number of solenostomes and movable digit dentition, the peritreme length should also be used for species diagnosis, as discussed earlier. *Kampimodromus elongatus* (Oudemans, 1930) was synonymized with *K. aberrans* by Chant, (1955) and Ragusa Di Chiara and Tsolakis, (1994). As suggested by Chant and McMurtry (2003), we treated *K. elongatus* as a valid species due to the presence of sublateral setae *R1* on dorsal shield. *Kampimodromus adrianae* Ferragut & Peña-Estévez 2003, and *K. vitis* (Oudemans, 1930) are also considered junior synonyms of *K. hmiminai* McMurtry Bounfour and *K. aberrans*, respectively (Chant, 1955; Tixier *et al.* 2006).

Key to known species of the genus *Kampimodromus* Nesbitt

1. Six pairs of solenostomes on dorsal shield; one pair of preanal setae on ventrianal shield 2
— Less than six pairs of solenostomes on dorsal

shield; two or three pairs of preanal setae on ventri-
anal shield 3

2. Preanal solenostomes present *K. florinensis*
Papadoulis, Emmanouel and Kapaxidi
— Preanal solenostomes absent *K. hmiminai*
McMurtry and Bounfour

3. Three pairs of solenostomes on dorsal
shield..... *K. judaicus*
(Swirski and Amitai)
— Five or four pairs of solenostomes on dorsal
shield 4

4. Four pairs solenostomes on dorsal shield 5
— Five pairs of solenostomes on dorsal shield 9

5. Movable digit of chelicera smooth 6
— Movable digit of chelicera with one tooth..... 8

6. Sub-lateral setae *R1* inserted on dorsal
shield..... *K. elongatus*
(Oudemans)
— Sub-lateral setae *R1* on interscutal membrane . . 7

7. Preanal solenostomes present; Macroseta on ba-
sitarus IV short about 20 μm in length; dorsal setae
Z1 almost half-length of setae *S2* *K. aberrans*
(Oudemans)
— Preanal solenostomes absent; Macroseta on ba-
sitarus IV longer, about 30 μm in length; dorsal se-
tae *Z1* longer than half-length of setae *S2* (*Z1*=almost
2/3 length of S2) *K. molle*
(Ueckermann and Loots)

8. Peritreme short, extending to level of setae
z4..... *K. keae*
(Papadoulis and Emmanouel)
— Peritreme longer, extending to level of setae
z2..... *K. ragusai*
Swirski and Amitai

9. Ventrianal shield with two pairs of preanal se-
tae..... *K. alettae*
(Ueckermann and Loots)

— Ventrianal shield with three pairs of preanal se-
tae..... 10

10. Movable digit of chelicera with one tooth.... 11
— Movable digit of chelicera smooth..... 13

11. Peritreme short extending to level of sub-lateral
setae *r3*..... *K. echii*
Ferragut and Peña-Estévez
— Peritreme longer, at least extending to level
z2..... 12

12. Macroseta on basitarus IV pointed apically;
peritreme extending to level between setae *j3*-
z2..... *K. coryli*
Meshkov
— Macroseta on basitarus IV knobbed api-
cally; peritreme extending to setae level of
z2..... *K. langei*
Wainstein and Arutunjan

13. Dorsal setae *J2* shorter than 25 μm . . *K. corylosus*
Kolodochka
— Dorsal setae *J2* longer than 30 μm 14

14. Both dorsal setae *S5* and macrosetae on basitar-
sus IV smooth *K. karadaghensis*
Kolodochka
— Both dorsal setae *S5* and macrosetae on basitar-
sus IV slightly serrate *K. ericinus*
Ragusa Di Chiara and Tsolakis

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REFERENCES

- Arutunjan E.S. 1977 — Identification manual of phytoseiid mites of agricultural crops of the Armenian SSR. Akademiya Nauk Armyanskoi SSR, — Erevan, Armenia: Zoologicheskii Institute. pp. 177. [in Russian/Armenian].
- Athias-Henriot C. 1975 — Nouvelles notes sur la Amblyseiini. II. Le releve organotaxique de la face dorsale adulte (Gamasides Protoadenique, Phytoseiidae) — *Acarologia*, 17: 20-29.
- Athias-Henriot C. 1977 — Nouvelles notes sur la Amblyseiini. III. Sur la genre *Cydnodromus*: redefinition, composition (Parasitiformes, Phytoseiidae) — *Entomophaga*, 22: 61-73. doi:10.1007/BF02372991
- Chant D.A. 1955 — Notes on mites of the genus *Typhlodromus* Scheuten, 1857 (Acarina: Laelaptidae), with descriptions of the males of some species and the female of a new species — *Can. Entomol.*, 87: 496-503. doi:10.4039/Ent87496-11
- Chant D.A., McMurtry J.A. 2003 — A review of the subfamily Amblyseiinae Muma (Acari: Phytoseiidae): Part II. The tribe Kampimodromini Kolodochka — *Int. J. Acarol.*, 29: 179-224. doi:10.1080/01647950308684331
- Chant D.A., McMurtry J.A. 2007 — Illustrated keys and diagnoses for the genera and subgenera of the Phytoseiidae of the world (Acari: Mesostigmata) — West Bloomfield: Indira Publishing House. pp. 219.
- Chant D.A., Yoshida-Shaul E. 1989 — Adult dorsal setal patterns of the family Phytoseiidae (Acari: Gamasina) — *Int. J. Acarol.*, 15: 219-233. doi:10.1080/01647958908683852
- Chant D.A., Yoshida-Shaul E. 1991 — Adult ventral setal patterns in the family Phytoseiidae (Acari: Gamasina) — *Int. J. Acarol.*, 17: 187-199. doi:10.1080/01647959108683906
- Chant D.A., Yoshida-Shaul E. 1992 — Adult idiosomal setal patterns in the family Phytoseiidae (Acari: Gamasina) — *Int. J. Acarol.*, 18: 177-193. doi:10.1080/01647959208683949
- Demite P.R., Moraes G.J. de, McMurtry J.A., Denmark H.A., Castilho R. C. 2016 — Phytoseiidae Database [Internet] — [14 June 2016]. Available from: (www.lea.esalq.usp.br/phytoseiidae/)
- Evans G.O. 1963 — Observations on the chaetotaxy of the legs in the free-living Gamasina (Acari: Mesostigmata) — *Bull. Brit. Mus. (Nat. Hist.) Zool.* 10: 277-303. doi:10.5962/bhl.part.20528
- Evans G.O., Till W.M. 1979 — Mesostigmatic mites of Britain and Ireland (Chelicerata: Acari-Parasitiformes): An introduction to their external morphology and classification — *Trans. Zool. Soc. London*, 35: 139-270. doi:10.1111/j.1096-3642.1979.tb00059.x
- Ferragut F., Peña-Estévez M.A. 2003 — Phytoseiid mites of the Canary Islands (Acari: Phytoseiidae): 1. Gran Canaria Island — *Int. J. Acarol.*, 29: 149-170. doi:10.1080/01647950308683654
- Kolodochka L.A. 1980 — New phytoseiid mites (Parasitiformes: Phytoseiidae) from Moldavia, USSR — *Vestn. Zoologii*, 4: 39-45 [in Russian].
- Lindquist E.E., Evans G.O. 1965 — Taxonomic concepts in the Ascidae, with a modified setal nomenclature for the idiosoma of the Gamasina (Acarina: Mesostigmata) — *Mem. Entomol. Soc. Can.*, 47: 1-64. doi:10.4039/entm9747fv
- Nesbitt H.H.J. 1951 — A taxonomic study of the Phytoseiidae (Family Laelaptidae) predaceous upon Tetranychidae of economic importance — *Zool. Verhandl.*, 12: 64 pp.+ 32 plates.
- Oudemans A.C. 1930 — *Acarologische Aanteekeningen*. CI. — *Entomol. Ber.*, 8: 48-53.
- Papadoulis G.Th., Emmanouel N.G. 1991 — Two new species of *Amblyseius* Berlese (Acari: Phytoseiidae) from Greece — *Int. J. Acarol.*, 17: 265-269. doi:10.1080/01647959108683917
- Papadoulis G.Th., Emmanouel N.G., Kapaxidi E.V. 2009 — *Phytoseiidae of Greece and Cyprus* (Acari: Mesostigmata) — West Bloomfield: Indira Publishing House. pp. 200.
- Ragusa Di Chiara S., Tsolakis H. 1994 — Revision of the genus *Kampimodromus* Nesbitt, 1951 (Parasitiformes, Phytoseiidae), with a description of a new species — *Acarologia*, 35: 305-322.
- Rowell H.L., Chant D.A., Hansell R.I.C. 1978 — The determination of setal homologies and setal patterns on the dorsal shield in the family Phytoseiidae (Acarina: Mesostigmata) — *Can. Entomol.*, 110: 859-876. doi:10.4039/Ent110859-8
- Swirski E., Amitai S. 1997 — Notes on phytoseiid mites (Mesostigmata: Phytoseiidae) of Mt. Carmel (Israel), with descriptions of two new species — *Isr. J. Entomol.*, 31: 1-20.
- Swirski E., Ragusa Di Chiara S., Tsolakis H. 1998 — Keys to the phytoseiid mites (Parasitiformes, Phytoseiidae) of Israel — *Phytophaga*, 8: 85-154.
- Tixier M.-S., Kreiter S., Cheval B., Auger P. 2003 — Morphometric variation between populations of *Kampimodromus aberrans* (Oudemans) (Acari: Phytoseiidae): implications for the taxonomy of the genus — *Invertebr. Syst.*, 17: 349-358. doi:10.1071/IS02004
- Tixier M.-S., Kreiter S., Ferragut F., Cheval B. 2006 — The suspected synonymy of *Kampimodromus hmiminai* and


Kampimodromus adrianae (Acari: Phytoseiidae): morphological and molecular investigations — Can. J. Zool., 84: 1216-1222. doi:10.1139/z06-108

Tixier M.-S., Kreiter S., Croft B.A., Cheval B. 2008 — *Kampimodromus aberrans* (Acari: Phytoseiidae) from the USA: morphological and molecular assessment of its density — Bull. Entomol. Res., 98: 125-134. doi:10.1017/S0007485307005457

Ueckermann E.A., Loots G.C. 1985 — The African species of the subgenus *Kampimodromus* Nesbitt (Acarina: Phytoseiidae) — Phytophylactica, 17: 195-200.

Wainstein B.A. 1973 — On the structure of some organs of Phytoseiidae (Parasitiformes) important for taxonomy — Zool. Zhurnal 52: 1871-1872.

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