



## Mites of the genus *Prozercon* (Acari: Zerconidae) in Dilek Peninsula-Büyük Menderes Delta National Park (Turkey), with description of a new species

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**ASBTRACT:** In the present paper, zerconid mites of the genus *Prozercon* were collected from the Dilek Peninsula-Büyük Menderes Delta National Park, Didim County, Aydın Province (western Turkey). After identification processes, three *Prozercon* species were found in the research area, among them, *P. didimensis* sp. nov. was described and illustrated as a new species for the science. Also, altitude and habitat preferences of the species were given and discussed.

**Keywords:** Mesostigmata, zerconid mites, new species, preference, Didim, Aydın.

**Zoobank:** <http://zoobank.org/739128D7-32B1-4FC4-B81E-BAF2C5BD2EB3>

### INTRODUCTION

Zerconid mites (Zerconidae), which is one of the important mite families of soil mesofauna in the Holarctic region, are represented with two genera (*Prozercon* and *Zercon*) and 129 species in Turkey (Urhan and Karaca, 2019, 2020; Urhan et al., 2020, 2021; Bulut, 2020; Keçeci, 2020). Most of these species are endemic to Turkey and have been found during long-term researches in the country, especially based on various results of M.Sc. and Ph.D. theses. On the other hand, in many parts of Turkey systematics and ecological researches are still ongoing on zerconid mites. Therefore, new species and records of zerconid mites are being increased day by day for the Turkish fauna.

National parks are protected areas in many countries in the world which include various kinds of floral and faunal elements, and are always great attractions for scientists. Turkey is a rich country in terms of number of national parks with 44 national parks, one of which is the Dilek Peninsula-Büyük Menderes Delta National Park, a protected area located in Kuşadası County of Aydın Province (western Turkey). No research on zerconid mites has been performed in this area so far. Therefore, the aim of this study is to reveal the species diversity of the family Zerconidae in that area systematically and ecologically.

In the present paper, diversity of these mites in the above-mentioned national park was investigated. A species list for the *Prozercon* species found in that area was given herein, including knowledge on their distributions, altitudinal and habitat preferences. Also, description and illustrations of a new species and a key for the *Prozercon* species in the research area were given.

### MATERIALS AND METHODS

All materials of zerconid mites were collected from the Dilek Peninsula-Büyük Menderes Delta National Park in a

period between December 2018 and May 2020 as part of a faunistic study. Sampling studies was carried out after obtaining legal permissions from the "Republic of Turkey Ministry of Forestry and Water Affairs, General Directorate of Nature Conservation and National Parks (72784983-488.04-51504)". For revealing species richness of zerconid mites in the research area, different materials (plant litter, soil and moss samples) were collected from suitable habitats, especially from forestland areas. All materials were taken from 97 different localities. The GPS data for collecting localities, including coordinates and altitudes, was taken using a Garmin GPSMap 62S.

All collected samples were transferred to the acarology laboratory of Pamukkale University for identification processes. Firstly, all collected materials were put in the Berlese-Tullgren funnels for extraction of mite specimens during 5-7 days. Zerconid specimens were selected using an Olympus SZ51. Then, they were preserved in 70% ethanol, cleared in 60% lactic acid, and finally mounted on microscope slides using Hoyer's medium. The specimens were identified using an Olympus CX41 and all illustrations were drawn with DP25 camera attached to an Olympus BX50 microscope. All examined *Prozercon* specimens were deposited at acarology laboratory of Pamukkale University, Denizli, Turkey. The idiosomal setation follows Lindquist and Evans (1965), with modifications for the caudal region as given by Lindquist and Moraza (1998). Terminology for idiosomal adenotaxy and poroi-dotaxy follows that of Johnston and Moraza (1991). All measurements, including scale bars of the figures, are given in micrometers ( $\mu\text{m}$ ). Abbreviation of DN was used for deutonymph specimens.

### RESULTS

Family Zerconidae Canestrini, 1891

Genus *Prozercon* Sellnick, 1943

Type species: *Zercon fimbriatus* C. L. Koch, 1839

Posterior parts of peritremal shields extending to setae *R4* or *R5*. Two setae present on peritremal shields: *r1* short, smooth or finely plumose, *r3* short and smooth. No gap between peritremal shield and the edge of the podonotum. Adgenital shields absent. Opisthonotum with seven or eight pairs of marginal setae (*S1* + *R1–R6* or *S1* + *R1–R7*). Anterior margin of ventrianal shield always with two setae (Karaca et al., 2017).

*Prozercon didimensis* sp. nov. (Figures 1-2)

Zoobank: <http://zoobank.org/8395C5CC-80D5-4BDE-8D8C-C51DE33169E2>

Type material. Holotype (female), soil and litter samples under strawberry tree (*Arbutus* sp.), 37°29.664' N, 27°20.381' E, 85 m a.s.l., vicinity of Söke-Milas road, fork of Didim road, Aydın Province, 8 April 2020. Paratypes: 6 females, same data as holotype; 5 females, soil and litter samples under olive tree (*Olea europaea*), same data as holotype.

Diagnosis. Anterior margin of ventrianal shield with two pairs of setae. All podonotal setae finely barbed (except seta *j5*). Seta *j5* short, smooth and needle-like. All opisthonotal setae finely barbed in various lengths, marginal setae shorter than others. Pores *gdS2* located between setae *Z2* and *S2*, *gdZ3* located between setae *J4* and *Z4*, closer to *Z4*. Dorsal cavities weakly developed. Podonotum covered with tile-like and reticulate pattern, opisthonotum covered by irregular punctate pattern.

Female (Figs 1–2). Length (without gnathosoma) and width in holotype 305 and 232, respectively. Measurements of 11 paratypes: length 296–315, width 224–247. Dorsal fossae indistinct and weakly sclerotized.

Dorsal side. (Fig. 1). Twenty pairs of setae present on podonotum: setae in *j* series with six pairs, *z* series with five pairs, *s* series with six pairs and *r* series with three pairs. All of them finely or densely plumose (except seta *j5*). Setae *j1* and *s3* markedly elongated, densely plumose and brush-like. Seta *j5* short, smooth and needle-like. Setae *j2*, *s1* and *z2* shorter than other podonotal setae. Remaining podonotal setae approximately as the same length. Except seta *s3*, all marginal setae in *r* series situated as parallel to lateral margin of podonotum. Twenty one pairs of setae present on opisthonotum: setae in *J* series with five pairs, *Z* series with five pairs, *S* series with five pairs and *R* series with six pairs. All of them finely or densely plumose. In *J* series, only seta *J5* reaching base of following seta. Seta *Z5* unilateral plumose in contrary of other setae in *J* series, situated as parallel to posterior margin of opisthonotum. None of setae in *Z* series reaching the base of following seta. Seta *JV5* similar to *Z5*. None of setae in *S* series reaching the base of following seta. All setae in *S* series situated as parallel to lateral margin of opisthonotum. Seta *S2* not reaching lateral margin of opisthonotum, seta *S3* reaching lateral margin of opisthonotum, but setae *S4* and *S5* reaching beyond of opisthonotum. All marginal setae (*S1* + *R1–R6*) situated as parallel to lateral margin of opisthonotum. The interval between

setae *Z5* and *JV5* 21–24. Length of the opisthonotal setae and distance between setal bases within longitudinal *J*, *Z* and *S* rows are given in Table 1 for female specimens of *P. didimensis* sp. nov.

Pores. (Fig. 1). On podonotum, pores *gds1* located on the line connecting setae *j3–s1*, closer to *s1*. Pores *gdj4* located on the line connecting setae *j4–z4*, closer to *z4*. Pores *gds4* located on the line connecting setae *s4–s5*, closer to *s5*. On opisthonotum, pores *gdZ1* located above the base of setae *Z1*. Pores *gdS2* located on the line connecting setae *Z2–S2*. Pores *gdZ3* located on the line connecting setae *J4–Z4*, closer to *Z4*. Pores *gdS5* located closer to base of setae *S5*.

Ventral side. (Fig. 2). Chaetotaxy and shape of the peritrematal shields normal for the genus *Prozercon*. Posterolateral tips of peritrematal shield reaching the level of setae *R2–R3*. Peritrematal shield with two pairs of setae (*r1* and *r3*), both short, smooth and needle-like. Peritremes similar to reverse comma. Sternal shield with three pairs of setae (*st1–3*), genital shield with one seta (*st5*), and one seta (*st4*) present between sternal and epigynal shield, all of them short, smooth and needle-like. Glands *gv2* absent between posterior section of genital shield and anterior section of ventrianal shield. Ventrianal shield with eight pairs of setae (*JV1–JV3*, *ZV2–ZV4*, *JV4* and *Ad*) and one single postanal seta (*Pa*), all short, smooth and needle-like. Postanal seta as the longest on the ventrianal shield. Anterior margin of ventrianal shield with two setae (*JV1*).

Male and immature stages. Not found.

Etymology. The specific epithet '*didimensis*' refers to the Didim County (Aydın Province) where the new species was collected.

Remarks. *Prozercon didimensis* sp. nov. is quite similar to *P. banazensis* Urhan, Karaca and Duran, 2015, *P. erdogani* Urhan, 2010 and *P. martae* Ujvári, 2010. The distinctive morphological features of these four species were given in Table 2.

**Table 1.** Maximum and minimum ranges of opisthonotal setae and the distances between their bases in *J*, *Z*, and *S* rows of *Prozercon didimensis* sp. nov. (females).

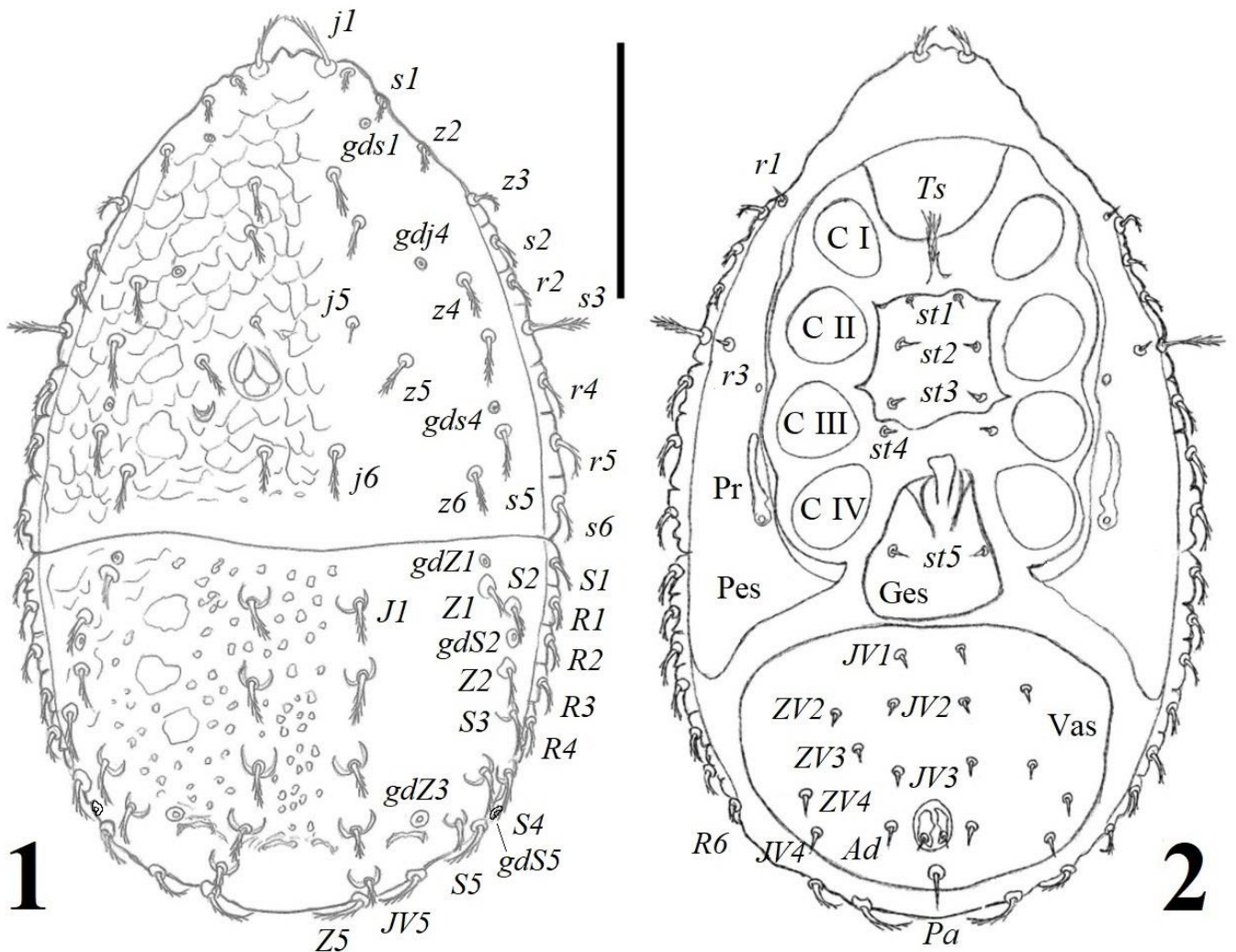
Setae	♀	Setae	♀	Seta	♀
<i>J1</i>	20–21	<i>Z1</i>	16–18	<i>S1</i>	18–22
<i>J1–J2</i>	25–31	<i>Z1–Z2</i>	35–38	<i>S1–S2</i>	20–25
<i>J2</i>	22–26	<i>Z2</i>	15–18	<i>S2</i>	18–20
<i>J2–J3</i>	30–37	<i>Z2–Z3</i>	29–34	<i>S2–S3</i>	31–35
<i>J3</i>	18–21	<i>Z3</i>	18–20	<i>S3</i>	18–19
<i>J3–J4</i>	22–27	<i>Z3–Z4</i>	17–23	<i>S3–S4</i>	22–29
<i>J4</i>	15–16	<i>Z4</i>	11–12	<i>S4</i>	18–21
<i>J4–J5</i>	18–21	<i>Z4–Z5</i>	45–56	<i>S4–S5</i>	18–22
<i>J5</i>	12–15	<i>Z5</i>	17–20	<i>S5</i>	20–23

Materials examined: Three females: soil and litter samples under oak tree (*Quercus* sp.), 37°39.598' N, 27°6.434' D, 814 m a.s.l., vicinity of radar surveillance area of "Naval Forces Command", 10 December 2018. Nine females: soil and litter samples under sage-leaved rock-rose (*Cistus salvifolius*), 37°44.784' N, 27°20.967' D, 200 m a.s.l., vicinity of Söke-Davutlar neighborhoods road, 14 May 2019. One female: soil and litter samples under Turkish pine (*Pinus brutia*), 37°38.899' N, 27°15.744' D, 10 m a.s.l., Yuvacaköy neighborhood, 14 May 2019. Four females and two males: soil and litter samples under olive tree (*Olea europaea*), 37°37.283' N, 27°11.763' D, 12 m a.s.l., vicinity of Tuzburgazı neighborhood, 14 May 2019. One female: soil and litter samples under oleaster-leaved pear (*Pyrus*

*elaeagrifolia*), 37°41.121' N, 27°17.595' D, 892 m a.s.l., Dilek Mountain, 31 August 2019. One female: soil and litter samples under kermes oak (*Quercus coccifera*), 37°42.213' N, 27°17.990' D, 385 m a.s.l., vicinity of Kurşunlu Monastery, Davutlar neighborhood, 9 November 2019. Six females: soil and litter samples under holly oak (*Quercus ilex*), 37°42.624' N, 27°18.512' D, 277 m a.s.l., vicinity of Kurşunlu Monastery, Davutlar neighborhood, 9 November 2019. One female: moss samples, 37°41.798' N, 27°9.436' D, 21 m a.s.l., vicinity of Kavaklıburun Bay, 3 February 2020.

Turkish distribution: Aydın, Balıkesir, Denizli, İstanbul, Muğla (Karaca, 2015, 2021).

Known distribution: Turkey (Urhan, 1998), Crete, Greece (Ujvári, 2008, 2011).



**Figures 1–2.** *Prozercon didimensis* sp. nov. (female) **1.** Dorsal view, **2.** Ventral views. Abbreviations: (*r1* and *r3*) peritremal setae, (*Pr*) peritreme, (*Pes*) peritremal shield, (*Ts*) tritosternum, (*C I–C IV*) endopodal shields, (*st1–5*) sternal setae, (*Ges*) genital shield, (*Vas*) ventrianal shield, (*JV1–JV3*, *ZV2–ZV4* and *JV4*) ventrianal setae, (*Ad*) adanal setae and (*Pa*) postanal seta. Scale bar 100.

**Table 2.** Morphological distinguishing characters for *P. didimensis* sp. nov., *P. banazensis*, *P. erdogani* and *P. martae*.

Characters	<i>P. didimensis</i> sp. nov.	<i>P. banazensis</i> Urhan, Karaca and Duran, 2015	<i>P. erdogani</i> Urhan, 2010	<i>P. martae</i> Ujvári, 2010
<b>Setae in J series</b>	Only seta J5 reach to base of following seta	Except setae J1 and J2, J3–J5 reach to base of following seta	Except setae J1 and J2, J3–J5 reach to base of following seta	Except setae J1, J2–J5 reach to base of following seta
<b>Seta J6</b>	situated as parallel to posterior margin of opisthonotum	situated as parallel to posterior margin of opisthonotum	situated vertically to posterior margin of opisthonotum	situated vertically to posterior margin of opisthonotum
<b>Seta Z3</b>	finely barbed	phylliform and finely serrate marginally	plumose	plumose
<b>Seta S2</b>	finely barbed	finely barbed	plumose	plumose
<b>Seta S3</b>	finely barbed	phylliform and finely serrate marginally or smooth	absent	plumose
<b>Seta S4</b>	situated as parallel to lateral margin of opisthonotum	situated vertically to lateral margin of opisthonotum	situated vertically to lateral margin of opisthonotum	situated vertically to lateral margin of opisthonotum
<b>Pore Po2</b>	located between setae Z2 and S1	located between setae S1 and R3, closer to S1	located between setae Z2 and S1	inside the line connecting Z2 and S1, closer to S1
<b>Pore Po3</b>	located between setae J4 and Z4	located between setae J4 and Z3	located between setae J3 and Z4	located under the line connecting Z3 and S3

**Table 3.** Altitude preferences of *Prozercon* species in the Dilek Peninsula-Büyük Menderes Delta National Park.

Altitudinal ranges (m)	<i>P. didimensis</i> sp. nov.	<i>P. umidicola</i> Urhan, 2002	<i>P. yavuzi</i> Urhan, 1998
0–50			
50–100	+		
100–150			+
150–200			
200–250			+
250–300			+
300–350			+
350–400			
400–450			
450–500		+	+
500–550			
550–600			
600–650			+
650–700			
700–750			
750–800			
800–850			+
850–900			
900–950			
950–1000			

**Table 4.** Habitat preferences of *Prozercon* species in the Dilek Peninsula-Büyük Menderes Delta National Park.

Habitat types	<i>P. didimensis</i> sp. nov.	<i>P. umidicola</i> Urhan, 2002	<i>P. yavuzi</i> Urhan, 1998
<i>Olea europaea</i>	+	+	
<i>Pistacia</i> sp.	+		
<i>Pinus brutia</i>			+
<i>Pinus nigra</i>			+
<i>Quercus</i> sp.			+

Key to *Prozercon* species in the Dilek Peninsula-Büyük Menderes Delta National Park

**1** All marginal setae on opisthonotum pilose or plumose. Seta *S4* present ..... **2**

**1'** All marginal setae on opisthonotum (except seta *S1*) short, smooth and needle-like. Seta *S4* absent ..... *P. yavuzi* Urhan, 1998

**2** Marginal setae on opisthonotum with seven pairs (*S1* + *R1*-*R6*), seta *Z5* situated as parallel to posterior margin of opisthonotum ..... *P. didimensis* sp. nov.

**2'** Marginal setae on opisthonotum with seven pairs (*S1* + *R1*-*R7*), seta *Z5* situated as vertically to posterior margin of opisthonotum ..... *P. umidicola* Urhan, 2002

#### Altitude preferences of *Prozercon* species in the Dilek Peninsula-Büyük Menderes Delta National Park

All materials for the *Prozercon* species were collected from suitable forestland areas at the altitude from 0 to 1000 m a.s.l. All sampling areas were divided according to 50 meters elevation ranges. After identification processes in the laboratory, the altitudinal distribution results of the *Prozercon* species were marked in Table 3.

According to Table 3, *P. didimensis* sp. nov. occurs only at lower altitudes (50-100 m a.s.l.). In addition, *P. umidicola* was only found at 450-500 m a.s.l. zones. However, since *P. yavuzi* showed a wide range of occurrences from 100 to 850 m a.s.l., it has no clear preference in terms of altitudinal ranges, but can live in low to mid-land areas.

#### Habitat preferences of *Prozercon* species in the Dilek Peninsula-Büyük Menderes Delta National Park

Samplings for *Prozercon* species were carried out in 97 different localities and the following 23 habitat types, mostly tree species, were noted: broom (*Genista* sp.), carob (*Ceratonia siliqua*), fern (*Pteridium aquilinum*), hawthorn (*Crataegus* sp.), juniper (*Juniperus* sp.), mastic (*Pistacia* sp.), moss (unspecified), mullein (*Verbascum* sp.), myrtle (*Myrtus communis*), oak (*Quercus* sp.), oleaster-leaved pear (*Pyrus elaeagrifolia*), olive (*Olea europaea*), pine (*Pinus brutia* and *P. nigra*), raspberry (*Rubus* sp.), rockrose (*Cistus* sp.), shrub (*Daphne gnidioides*), strawberry tree (*Arbutus* sp.), sycamore (*Platanus orientalis*), tamarisk (*Tamarix* sp.), thorn (*Paliurus spinachristi*), thorny burnet (*Sarcopoterium spinosum*) and walnut (*Juglans regia*). Habitat preferences of *Prozercon* species were marked in Table 4.

According to Table 4, all *Prozercon* specimens were found only in five different habitats (*Olea europaea*, *Pistacia* sp., *Pinus brutia*, *P. nigra* and *Quercus* sp.). In the remaining habitats, no specimens of *Prozercon* were found.

#### Authors' contributions

**Büşra Keçeci:** Investigation, collection of specimens (lead), methodology (equal), writing - original draft (supporting), preservation. **Raşit Urhan:** Funding acquisition, methodology (equal), project administration, supervision (lead), collection of specimens (supporting), identification, illustration. **Mehmet Karaca:** Data curation, formal analysis, methodology (equal), supervision (supporting), writing - original draft (lead), writing - review & editing, collection of specimens (supporting).

#### Statement of ethics approval

Not applicable.

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#### Conflict of interest

No potential conflict of interest was reported by the authors.

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