



A new sexually dimorphic species of *Pirnodus* (Acari, Oribatida, Oripodidae) associated with trees in southern Vietnam

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ABSTRACT

Pirnodus (Oribatida, Oripodidae) currently comprises seven species, collectively distributed in the tropical and southern Palaearctic areas. A new arboreal species – *P. arboreus* **sp. nov.** – is described, based on adults collected from branches of different trees in the Cat Tien National Park, southern Vietnam. The new species is characterized by distinct sexual dimorphism, e.g., interlamellar seta long, setiform in females versus medium-sized, phylliform in males, posterior part of notogaster not depressed in females versus depressed in males, notogastral seta *h*₁ well developed, setiform in females versus vestigial in males, notogastral seta *lm* located medial to *la* in females versus anteromedial in males, genital and anal apertures distanced from each other in females versus genital aperture shifted to anal aperture and connected to it in males, and dorsal side of tarsi I and II without tooth in females versus with tooth in males. Summary of distribution and habitats of the known species of *Pirnodus* are provided.

KEYWORDS

Arboreal habitat, morphology, Oriental region, oripodid mites, sexual dimorphism, taxonomy

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INTRODUCTION

Behan-Pelletier (2015) summarized data on brachypyline oribatid mites (Acari, Oribatida) with distinct sexual dimorphism. In the last decade, several new sexually dimorphic species have been described (e.g., Bayartogtokh *et al.* 2017; Shimano and Aoki 2019; Ermilov *et al.* 2022, 2023; Pfingstl *et al.* 2022; Ermilov and Salavatulin 2024).

During taxonomic identification of new oripodid materials collected from trees within the Cat Tien National Park, southern Vietnam, a new species of *Pirnodus* (Oripodidae) with distinct sexual dimorphism was found. The main goal of the paper is to describe one new species under the name *Pirnodus arboreus* **sp. nov.** and to compile data on distribution and habitats of the *Pirnodus* species.

The genus *Pirnodus* was proposed by Grandjean (1956), with *Pirnodus detectidens* Grandjean, 1956 as type species. The genus comprises seven species, which are distributed in tropics and the southern Palaearctic region (Ermilov and Salavatulin 2023; Ermilov *et al.* 2024). The generic diagnosis as well as an identification key to the species of *Pirnodus* was presented by Ermilov and Salavatulin (2023).

Prior to this research, two species of *Pirnodus*—*P. concavus* Ermilov, Salavatulin & Kontschán, 2024 and *P. partiarus* Ermilov & Salavatulin, 2023—were recorded from Vietnam (Ermilov and Salavatulin 2023; Ermilov *et al.* 2024).



MATERIAL AND METHODS

Samples of tree branches were collected via climbing (using climbing spikes and other special equipment) at the height of 15–25 m above ground in Cat Tien National Park, southern Vietnam. Mites were subsequently extracted by high-pressure flushing and further by heptane flotation in laboratory conditions. Detailed descriptions of arboreal acarofauna collection and extraction techniques are presented in Salavatulin (2019). The collection locality is given in the *Type material* section.

For measurement and illustration, specimens were mounted in lactic acid on temporary cavity slides. All body measurements are presented in micrometers (µm). Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the notogaster. Body width refers to the maximum width of the notogaster in dorsal view. Setae were measured from the side to avoid foreshortening. Paired structures are described in the singular, unless otherwise noted. Formulas for leg setation are given in parentheses according to the sequence trochanter-femur-genu-tibia-tarsus (femulus of tarsus I included). Formulas for leg solenidia are given in square brackets, according to the sequence genu-tibia-tarsus. Drawings were made with a camera lucida using a Leica DM 2500 light microscope. For SEM microscopy alcohol-preserved mites were coated with gold and scanned using a TESCAN Mira3 LMU SEM microscope.

Morphological terminology used in this paper mostly follows that of Grandjean (e.g., 1956). Leg setal nomenclature follows Norton (1977).

The following morphological abbreviations are used: *Prodorsum*: *lam* = lamella; *plam* = prolamella; *ro*, *le*, *in*, *bs* = rostral, lamellar, interlamellar, and bothridial setae, respectively; *P* = pleurophragma. *Notogaster*: *dep* = depression; *c*, *la*, *lm*, *lp*, *b₁–b₃*, *p₁–p₃* = setae; *Sa*, *S1*, *S2*, *S3* = saccules; *ia*, *im*, *ip*, *ih*, *ips* = lyrifissures; *gla* = opisthonotal gland opening. *Gnathosoma*: *a*, *m*, *b* = subcapitular setae; *or* = adoral seta; *d*, *l*, *cm*, *acm*, *ul*, *su*, *lt*, *vt*, *inf*, *sup* = palp setae; ω = palp solenidion; *ep* = postpalpal seta; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. *Epimeral and lateral podosomal regions*: *1a*, *1b*, *1c*, *2a*, *3a*, *3b*, *4a* = epimeral setae; *Am* = humeral porose area. *Anogenital region*: *g*, *an*, *ad* = genital, anal, and adanal setae, respectively; *iad* = adanal lyrifissure; *po* = preanal organ. *Legs*: *pa* = porose area; *e* = femulus; *d*, *l*, *v*, *ev*, *bv*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv* = setae; ω , σ , φ = solenidia.

RESULTS

TAXONOMY

Family Oripodidae

Genus *Pirnodus* Grandjean, 1956

Type species: *Pirnodus detectidens* Grandjean, 1956

Pirnodus arboreus sp. nov. (Figs 1–21)

<http://zoobank.org/urn:lsid:zoobank.org:act:074A5FB0-465D-4094-832E-1CAAB50169F2>

Type material

Holotype (female) and five paratypes (three females and two males): southern Vietnam, Dong Nai Province, Dong Nai Biosphere Reserve, Cat Tien National Park, 11° 25' N, 107° 25' E, about 130 m a.s.l., branches from the Lauraceae tree at the height of 15–25 m above ground, December 2021 (collected by V.M. Salavatulin).

The holotype is deposited in the collection of the Senckenberg Museum of Natural History, Görlitz, Germany. Five paratypes are deposited in the collection of the University of Tyumen, Museum of Zoology, Tyumen, Russia. All specimens are preserved in 70% solution of ethanol with a drop of glycerol.

Additional (non-type) material

Fifteen adults (12 females and three males): label as for the type material. Two adults (two females):

label as for the type material, but branches from the *Polyalthia* sp. (Annonaceae) tree, December 2021. Two adults (two females): label as for the type material, but branches from the *Dipterocarpus turbinatus* (Dipterocarpaceae) tree, December 2021. One adult (one female): label as for the type material, but branches from the *Mangifera* sp. (Anacardiaceae) tree, December 2021. Two adults (one female and one male): label as for the type material, but branches from the unknown tree, December 2021.

All specimens (in 70% solution of ethanol with a drop of glycerol) are in the personal collection of the first author.

Diagnosis

Body length 195–270. Body surface densely microfoveolate. Rostrum slightly concave medially. Prolamella present. Translamella, sublamella, sublamellar porose area, and keel-shaped ridge absent. Rostral and lamellar setae setiform, barbed. In females, interlamellar seta setiform, barbed versus in males, *in* phylliform, barbed. Relative length of setae in females $in > le > ro$, in males $le > ro = in$. Bothridial seta fusiform, barbed. Exobothridial seta and dorsophragma absent. Anterior margin of notogaster truncate. Pteromorph reduced. Humeral region oblique. In males, posterior part of notogaster depressed. In females, all notogastral setae short, setiform, roughened, with *lm* located medial to *la* versus in males, notogastral seta *h*₁ vestigial, other setae short, setiform, roughened, with *lm* located anteromedial to *la*, and with *h*₁ and *p*₁ located close to each other in one transverse row. Four pairs of saccules with small, drop-like channel. Epimeral setal formula 3-1-2-1, with *1b* and *3b* longer than others. Pedotecta I and II reduced. Discidium and circumpedial carina absent. Genital plate smaller than anal plate. In females, genital and anal apertures distanced from each other versus in males, genital and anal apertures connected. Anogenital formula 1-0-2-3. In males, dorsal side of tarsi I and II with distinct tooth. Chaetome of legs strongly reduced.

Description

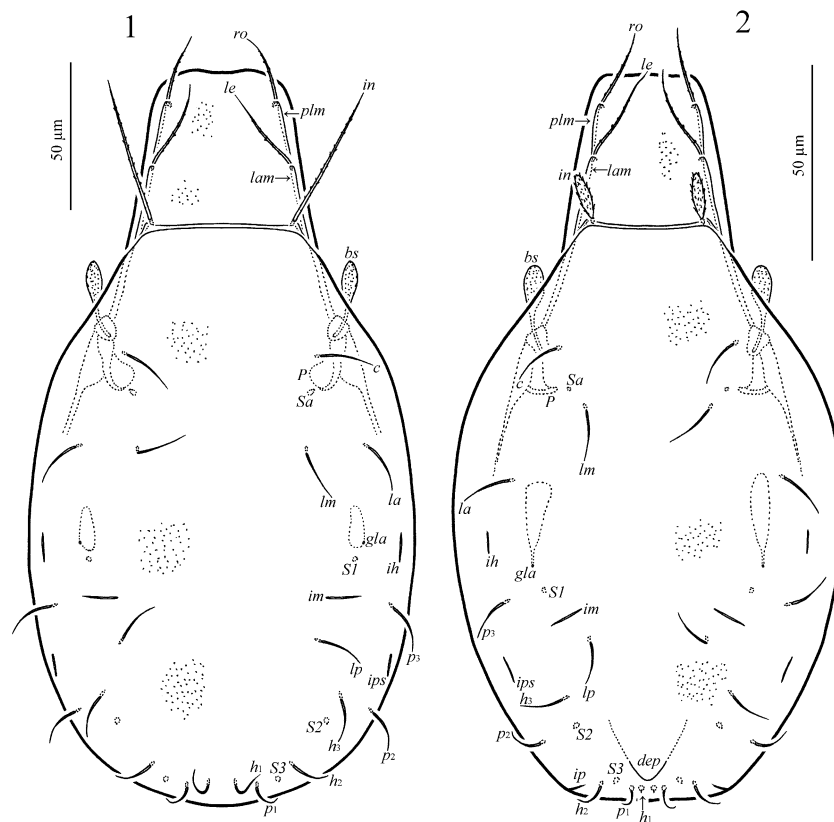
Measurements – Body length 255 (holotype), 255–270 (female paratypes), 195–210 (male paratypes). Notogaster width 150 (holotype), 135–150 (female paratypes), 105 (male paratypes).

Integument (Figs 19–21) – Body light yellowish to light brownish. Surface densely microfoveolate. Additionally, lateral side of prodorsum with thin, dense, slightly visible ridges and elongate tubercles.

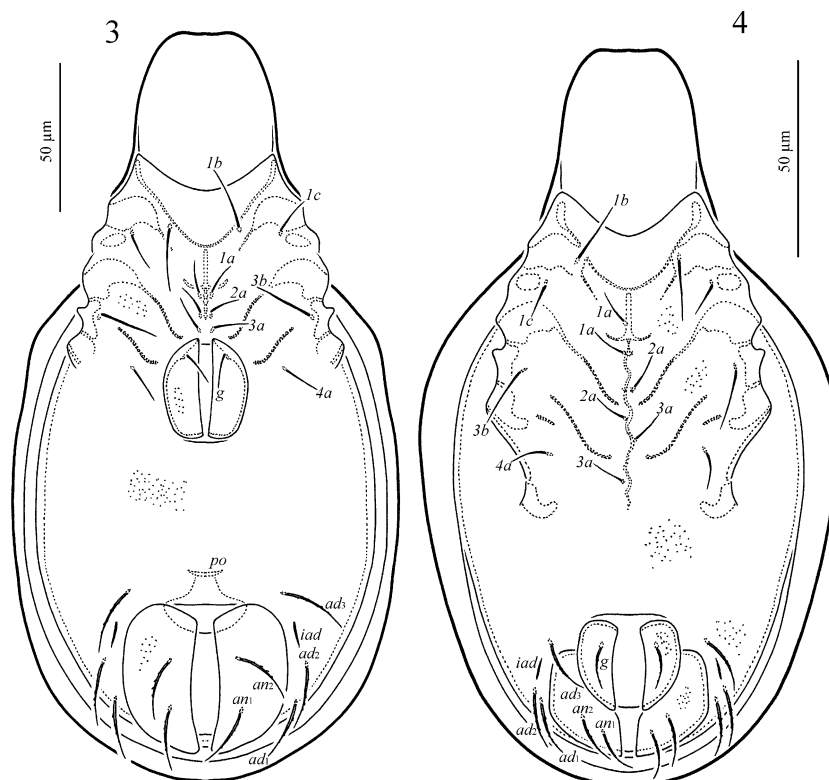
Prodorsum (Figs 1, 2, 5, 6, 18) – Rostrum slightly concave medially (visible in anterior view). Lamella shorter than length of prodorsum, lineate. Prolamella lineate, complete, but its distal part sometimes poorly developed. Translamella, sublamella, sublamellar porose area, and keel-shaped ridge absent. Rostral and lamellar setae (in females 30–34, in males 19–22) setiform, barbed. In females, interlamellar seta (52–60) setiform, erect, barbed; in males, interlamellar seta (17–22) phylliform, dilated in median part, barbed. Bothridial seta (in females 26–28, in males 19–22) fusiform, with short stalk and longer, barbed head. Head of bothridial seta partially covered by anterior margin of notogaster in dorsal view. Exobothridial seta (and its alveoli), dorsosejugal porose area, and dorsophragma absent. Pleurophragma visible.

Notogaster (Figs 1, 2, 5, 6, 18) – Anterior margin truncate. Pteromorph reduced. Humeral region sharply oblique. In males, posterior part of notogaster (anterior to setae *h*₁, *p*₁) depressed. In females, 10 pairs of notogastral setae (19–22) setiform, roughened, *lm* located medial to *la*. In males, notogastral seta *h*₁ (1) vestigial, others (*p*₁ 9; *c*, *la*, *lm*, *lp*, *h*₁–*h*₃, *p*₂, *p*₃ 13) setiform, roughened, *lm* located anteromedial to *la*, both pairs of setae *h*₁ and *p*₁ located close to each other in one transverse row. Four pairs of saccules with microopening and small, drop-like channel. Opisthonotal gland opening and all lyrifissures well visible.

Gnathosoma (Figs 9–11, 19–21) – Subcapitulum size 64–71 × 52–56 (in females), 49–52 × 37–41 (in males). Three pairs of subcapitular setae (in females, *a* 19–22, *m* 22–26, *b* 26–30, in males, *a* 11, *m* 15, *b* 19) setiform, barbed. Two pairs of adoral setae (in females 11–13, in males 7) setiform, barbed mediolaterally. Palp length 49–52 (in females), 34–37 (in males). Postpalpal seta (in females 7, in males 5) spiniform, roughened. Chelicera length 86–94 (in females), 60–64 (in males). Cheliceral seta *cha* (in females 30–32, in males 22) setiform, barbed, *chb* (in females 17–19, in males 13) setiform, roughened.



Figures 1–2. *Pirnodus arboreus* sp. nov., adult – 1. Female, dorsal view; 2. Male, dorsal view.



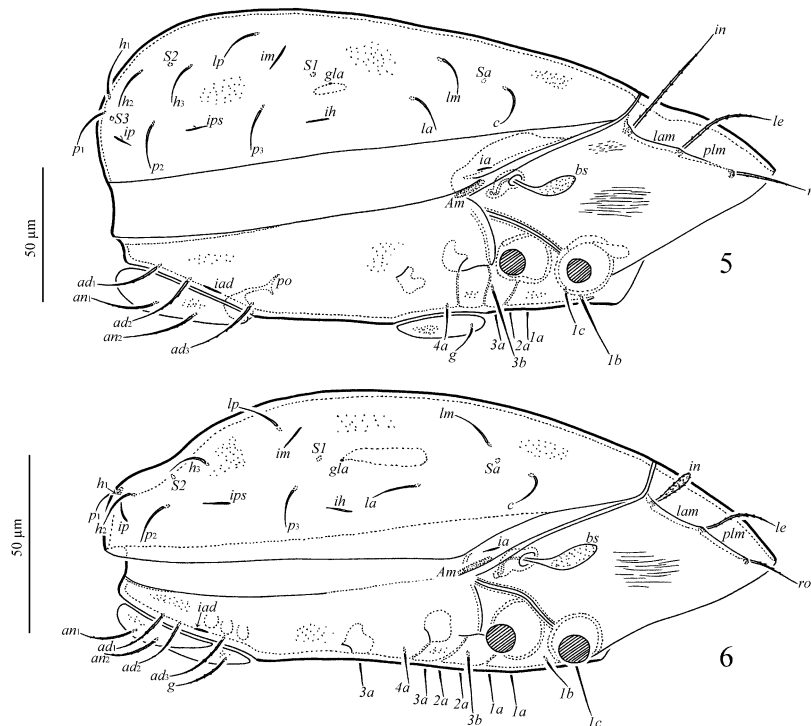
Figures 3–4. *Pirnodus arboreus* sp. nov., adult (gnathosoma and legs omitted) – 3. Female, ventral view; 4. Male, ventral view.

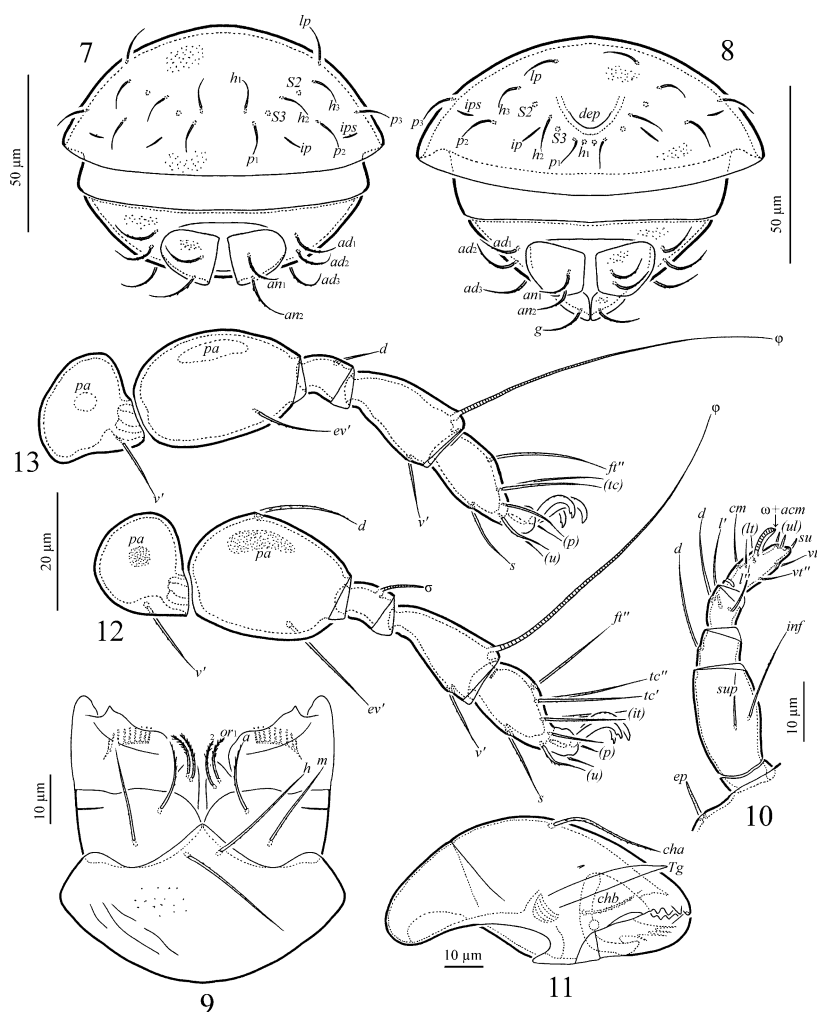
Epimeral and lateral podosomal regions (Figs 3–6, 20, 21) – Epimeral setal formula 3-1-2-1. All setae (in females, 1b, 3b 22–30, 1a, 1c, 2a, 3a, 4a 13–15, in males, 1b, 3b 17–22, 1a, 1c, 2a, 3a, 4a 9–11)

setiform, roughened. Pedotecta I and II reduced. Humeral porose area *Am* represented by elongate saccule, *Ab* absent. Discidium and circumpedial carina absent.

Anogenital region (Figs 3–8, 20, 21) – Genital plate smaller than anal plate. In females, genital and anal apertures distanced from each other, in males, genital aperture shifted to anal aperture and connected to it. Anogenital formula 1-0-2-3. In females, genital seta (13–15) setiform, roughened, in males, genital seta (15–19) setiform, barbed. Typical two pairs of aggenital setae (and their alveoli) absent. Anal and adanal setae (in females 26–30, in males 15–19) setiform, barbed. Adanal lyrifissure close and parallel to anal plate, located between insertions of adanal setae *ad*₂ and *ad*₃. Marginal porose area absent. Preanal organ well developed in females, not visible in males.

Legs (Figs 12–17, 19, 20) – Median and lateral claws thick, slightly different in thickness, slightly barbed on dorsal side. Lateral claws with tubercle distoventrally. Proximoventral porose area on tarsi I–IV and distoventral porose area on tibia I–IV absent. Dorsoparaxial porose area on femora I–IV and on trochanters III, IV distinct. In males, dorsal side of tarsi I and II with distinct tooth. Chaetome reduced, formulas of leg setation and solenidia: I (1-4-2-3-16) [1-2-2], II (1-4-2-2-13) [1-1-2], III (1-2-0-1-10) [1-1-0], IV (1-1-1-1-8) [0-1-0]. Homology of setae and solenidia indicated in Table 1.





Figures 7–13. *Pirnodus arboreus* sp. nov., adult – 7. Female, posterior view; 8. Male, posterior view; 9. Female, subcapitulum, ventral view; 10. Female, palp, right, antiaxial view; 11. Female, chelicera, left, paraxial view; 12. Female, leg III, right, paraxial view; 13. Female, leg IV, left, antiaxial view.

Remarks

In having medium-sized (shorter than length of anal plate), setiform anal and adanal setae, oblique humeral region, and the location of genital and anal apertures in males (genital aperture shifted to anal aperture and connected to it), *P. arboreus* sp. nov. is similar to *P. soyeri* Travé, 1969 (in 1969b). Main differences between the new species and *P. soyeri* are as follows: body size is smaller (length in females 255–270 versus 375–425, in males 195–210 versus 300–320 in *P. soyeri*); the prolamella is present (versus absent in *P. soyeri*); the interlamellar seta medium-sized, phylliform in the males (versus long, setiform in *P. soyeri*); the notogastral seta α_2 is absent in the females (versus present, long, subflagellate in *P. soyeri*); the notogastral seta h_1 is vestigial in the males (versus medium-sized, scimitar-shape in *P. soyeri*); all dorsal notogastral setae are similar in length (versus some setae clearly longer than others in *P. soyeri*); the notogastral seta lm is located anteromedial to la in the males (versus lateral in *P. soyeri*); both pairs of notogastral setae h_1 and p_1 are located close to each other (versus h_1 , p_1 distanced from h_1 , p_1 in *P. soyeri*); the epimeral seta $4b$ is absent (versus present in *P. soyeri*); the genital plate smaller than anal plate in the females (versus not smaller in *P. soyeri*); the aggenital setae are absent (versus present in *P. soyeri*); three pairs of adanal setae are present (versus two pairs in *P. soyeri*); the epimeral setae are comparatively short in the males (versus some setae are very long, subflagellate in *P. soyeri*); the leg tarsi I and II with dorsal tooth in the males (versus without tooth in *P. soyeri*); and the chaetome of legs more stronger reduced.



Figures 18–21. *Pirnodus arboreus* sp. nov., adult, SEM micrographs – 18. Female, dorsal view; 19. Female, subcapitulum, ventral view; 20. Female, ventral view; 21. Male, ventral view.

Table 2. Distribution and habitats of *Pirnodus* species.

Species	Habitats	Countries	References
<i>P. arboreus</i>	Branches from trees (Lauraceae, <i>Polyalthia</i> sp., <i>Dipterocarpus turbinatus</i> , <i>Mangifera</i> sp., unknown tree) at the height of 15–25 m above ground	Vietnam	Present data
<i>P. concavus</i>	Bark of <i>Dipterocarpus alatus</i> at the height of 15–25 m above ground	Vietnam	Ermilov <i>et al.</i> (2024); Ermilov and Salavatulin (2025)
<i>P. detectidens</i>	Crustose lichens on rocks	France, Spain	Grandjean (1956); Travé (1959, 1969a); Subías (1977)
<i>P. domrowi</i>	Wet sclerophyllous rain forest (substrate not specified)	Australia	Balogh and Mahunka (1978)
<i>P. imitans</i>	Epiphyton of bushes; moist zone	Argentina, Ecuador (Galápagos)	Balogh and Mahunka (1968); Schatz (1998)
<i>P. madegassus</i>	Degraded montane rain forest (substrate not specified)	Madagascar	Mahunka (1996)
<i>P. partiarus</i>	Branches from trees (<i>Dipterocarpus alatus</i> , <i>Haldina cordifolia</i>) at the height of 15–25 m above ground	Vietnam	Ermilov and Salavatulin (2023, 2025)
<i>P. soyeri</i>	Crustose lichens on rocks	Portugal (Savage Islands)	Travé, (1969a, b)

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Data availability: Data are available upon request from the senior authors.

Ethics approval: This study only included arthropod material, and all required ethical guidelines for the treatment and use of animals were strictly adhered to in accordance with international, national, and institutional regulations. No human participants were involved in any studies conducted by the authors for this article.

Consent for publication: All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

Generative AI statement: The authors declare that AI was not used at any stage of the manuscript development.

Conflict of interest: The authors declare no conflict of interest.

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یک گونه جدید دو شکلی جنسی از *Pirnodus* (Acari, Oribatida, Oripodidae) مرتبط با درختان در جنوب ویتنام

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چکیده

جنس *Pirnodus* (Oribatida, Oripodidae) در حال حاضر شامل هفت گونه است که به طور جمعی در مناطق گرمسیری و جنوبی پالتارکتیک پراکنده شده‌اند. گونه جدید درخت‌زی - *P. arboreus* sp. nov. - بر اساس هرناهای کامل جمع‌آوری شده از شاخه‌های درختان مختلف در پارک ملی کت تین، جنوب ویتنام، توصیف شده است. این گونه جدید با دوریختی جنسی متمایز مشخص می‌شود، برای نمونه، در ماده‌ها موهای بین تیغه‌ای بلند و مویی اما در مقابل در نرها اندازه متوسط، به صورت پهن است، قسمت عقبی شکم‌گرده در ماده‌ها فرورفته نیست در مقابل در نرها فرورفته، موهای شکم‌گرده‌ای h_1 به خوبی رشد کرده، مویی‌شکل در ماده‌ها اما در نرها تحلیل رفته است، موهای شکم‌گرده‌ای lm در ماده‌ها نسبت به la در قسمت میانی قرار دارند در مقابل در نرها قسمت جلویی میانی قرار گرفته‌اند، سوراخ تناسلی و مخرجی در ماده‌ها از یکدیگر فاصله دارند اما سوراخ تناسلی به سمت مخرج منتقل و در نرها به آن متصل شده‌اند، و قسمت پشتی پنجه‌های پاها یکم و دوم بدون دندان در ماده‌ها است در مقابل در نرها دندان دارد. چکیده‌ای از پراکندگی و زیستگاه‌های گونه‌های شناخته شده *Pirnodus* ارائه شده است.

واژگان کلیدی: زیستگاه درختی، ریخت‌شناسی، ناحیه شرقی، هرناهای اوریبویدید، دوریختی جنسی، آرایه‌شناسی

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