Description of juvenile stages and adults of two new nothroid mites from Ecuador (Acari: Oribatida: Nothridae)

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Abstract
The morphology of juvenile stages and adults of two new Neotropical oribatid mites from Ecuador is described and illustrated: Nothrus cotopaxiensis n. sp. and N. glaesarius n. sp. Comparison is made with juvenile stages and adults of similar species: Ethiopian species N. ijeensis Badejo, Woas and Beck, 2002, Japanese N. meakanensis Fujikawa, 1999 and N. silvestris Nicolet, 1855. Specimens were found in samples of moss, soil, litter, detritus from the forest patch, from under dwarf shrubs, below shrubs bordering the creek and in cushion plants. All samples were collected from Ecuador (provinces Pichincha, Imbabura and Cotopaxi, at 2750–3900 m a.s.l.).

Keywords: Nothrus cotopaxiensis n. sp., Nothrus glaesarius n. sp., Oribatida, Nothridae, morphology, juvenile stages, Ecuador, Neotropical region

Introduction
The moss-mite genus Nothrus (Oribatida: Crotonioidea: Nothridae) occurs throughout the whole world excluding the Antarctic Region. Only 12 species have been described from the Neotropical region so far (Subías 2004). In this paper juvenile stages and adults of two new species are described and compared to similar representatives of the genus.

The present paper is part of a study of the crotonioid mite fauna of Ecuador, based on the results of the circumtropical collecting programme launched in 1963 by Prof. J. Balogh. He and his co-workers concentrated the collecting partly in the Andes mountain range, partly in the Amazon Basin. They endeavoured to collect in all vegetation zones and these collections were extended with the aim to visit every country in South America, particularly Ecuador (Balogh 1988, 1989; Kuty 2005, 2006).

Several collecting expeditions in the Galápagos Island were carried out by Prof. H. Schatz. Among 202 oribatid species, which were encountered from these Ecuadorian islands, there were only two nothrid species: Nothrus biciliatus C. L. Koch, 1844 and N. oblongus Hammer, 1961 (Schatz 1998).
Materials and methods

The descriptions are based on the material from the Basel Natural History Museum, Switzerland. All samples were collected by Prof. A. Zicsi and Dr. I. Loksa from the provinces of Pichincha, Imbabura and Cotopaxi in Ecuador.

The mites were preserved in 75% ethanol and cleared in lactic acid. Two adults of *Nothrus cotopaxiensis*, one tritonymph and two adults of *N. glaesarius* were used in SEM. Specimens were examined with a scanning electron microscope in the Electron and Confocal Microscope Laboratory, A. Mickiewicz University, Poznań, Poland. They were mounted on stubs with double-sided stickytabs, coated with gold in a Balzers SPC 050 ion coater, and observed in a Philips 515 scanning electron microscope.

The holotype and eight paratypes of *Nothrus cotopaxiensis* n. sp., the holotype and 14 paratypes of *N. glaesarius* n. sp. are stored in the Basel Natural History Museum, Switzerland. Comparative material is stored in the collection of Dr. Ziemowit Olszanowski (Department of Animal Taxonomy and Ecology, A. Mickiewicz University, Poznań, Poland).

All specimens of *N. cotopaxiensis* (two larvae and 14 adults) come from four samples and *N. glaesarius* (one larva, two protonymphs, one deutonymph, four tritonymphs and 19 adults) from four samples.

List of localities. Ecuador

*N. cotopaxiensis* n. sp.

- Riverbank of Rio Alamo, 3 km from Nono, 2750 m; 4 February 1986; litter and soil from forest patch.
- Cotopaxi National Park, Province Cotopaxi; 26 February 1986; soil, detritus and tussocks.
- 8 km from Pifo, Province Pichincha, 2800 m; 18 February 1986; soil and litter from under dwarf shrubs in the upper third of the hollow.
- Cotacachi, on the banks of Rio Ambi, Province Imbabura; 22 February 1986; soil and detritus of reed.

*N. glaesarius* n. sp.

- 6 km from Psluguillo, Province Pichincha, 3900 m; 18 February 1986; cushion plants; tussocks and detritus; moss and cushion plants.
- Near Psluguillo, in the direction of Pifo, Province Pichincha, 3200 m; 18 February 1986; litter and soil from below shrubs bordering the creek.

Morphological terminology used in the descriptions follows that developed by F. Grandjean (see Travé and Vachon (1975) for references).

Taxonomy

*Nothrus cotopaxiensis* n. sp.

(Figures 1–8, 67–74)

*Larva* (Figures 1–2)

Body length: 365 μm, body width: 160 μm; colour: white.
Surface of prodorsum with round pits. Rostrum with median incision. Setae ro small, phylliform and frayed, bent, set on tubercles. Setae le similar to ro, set on apophyses. Setiform setae in shorter than le. Sensilli setiform, third as long as in. Setae ex setiform, half as long as in.

Notogaster narrowed posteriorly. Two pairs of elongated folds of thickened chitin run from setae c1–c2 to f1. Surface of plate covered with distinct, large, round pits; with 12 pairs of frayed and phylliform setae. Setae c2 as long as in, placed closer to c1 than to c3. Setae h1 longest, as long as distance between them. Oval opening of opisthosomal gland (gla) situated close to seta f2.

Pairs of epimeres medially separated. Epimeral setation: 3-1-3 (one seta extra on I and III epimeres). Genital, aggenital and adanal plates, and anal setae lacking.

All legs monodactylyous (setation not studied).
Adult (Figures 3–8, 67–74)

Body length: 830–900 µm (holotype: 850 µm), body width: 420–450 µm (holotype: 420 µm); colour: brown.
Prodorsal surface with round pits. Setae le three times longer than ro. Setae in frayed, as long as le. Sensilli thin, distally notched, almost twice longer as distance between their bases. Setae ex setiform and short.

Notogaster broadest at level of setae e2. Two pairs of elongated folds of thickened chitin run from setae c1–c2 to e2. Surface of plate between folds covered with distinct, large, round pits; lateral surface with small pits, posterior part with sparse pits. With 16 pairs of frayed and phylliform setae, thinner than in larva. Setae c2 placed closer to setae c1 than to c3. Setae h2 longest, as long as distance between their bases and as sensilli. Oval opening of opisthosomal gland (gla) situated close to seta f2.

Pairs of epimeres medially separated. Epimeral setation: 7-4-6-(4,5). Genital plates with nine pairs of short setae; two pairs of anal and three pairs of adanal setae. Aggenital setae lacking.

All legs tridactylous (setation not studied).

Remarks

The adult of *Nothrus cotopaxiensis* n. sp. shows some similarity to the Ethiopian species *Nothrus ifeensis* Badejo, Woas and Beck, 2002 and to the Japanese species *N. meakanensis* Fujikawa, 1999. All these species have long sensilli and one of the setae h elongated. However, *N. cotopaxiensis* n. sp. differs from these species by tarsi with three claws and frayed, phylliform setae. Comparison of selected morphological characters of adults of the above-mentioned species is given in Table I.

Fujikawa (1999) presented short descriptions of the larva and tritonymph of *N. meakanensis*, including figures of selected setae. The larva of *N. cotopaxiensis* n. sp. is similar to the larva of *N. meakanensis* having setae ro and le frayed, equally long. However, the larva of *N. cotopaxiensis* has sensilli three times shorter than setae in, setae ex as long as ss and broader, longer notogastral setae.

| Character | *N. cotopaxiensis* n. sp. | *N. ifeensis* | *N. meakanensis* |
|-----------|--------------------------|--------------|-----------------|
| Body length | 830–900 µm | 559–571 µm | 807–1000 µm |
| Body width | 420–450 µm | 297–309 µm | 428–621 µm |
| Colour | brown | dark brown | reddish brown |
| Number of claws | 3 | 1 | 1 |
| Setae le | le=3ro | le > ro | le > ro |
| Setae in | in=le | in=½ le | in=2le |
| Sensilli | apically slightly barbed | entirely barbed | entirely barbed |
| Setae e1, e2 | c2=½ c1, c2=ro | c2=½ c1, c2=½ ro | c2=½ c1, c2=ro |
| Setae e3 | c3=c1 | c3=c1 | c3 < c1 |
| Setae f1 | f1 < c1 | f1=c1 | f1=c1 |
| Setae f2 | f2=2 f1 | f2=f1 | f2=f1 |
| Setae h2 | h2=ss | h2=ss | h2=½ ss |
| Setae h3 | h3=h1 | -- | h3=½ h1 |
| Epimera | 7-4-6-(4, 5) | 7-5-6-5 | 5-3(4)-5-4(5) |
Etymology

*Nothrus cotopaxiensis* n. sp. is named after its locus typicus, Cotopaxi National Park, Ecuador.

*Nothrus glaesarius* n. sp.  
(Figures 9–66, 75–85)

**Larva** (Figures 9–17)

Body length: 380 µm, body width: 190 µm; colour: white

Rostrum with rostral incision. Surface of prodorsum with small pits. Setae *ro* delicately barbed, bent, slightly shorter than half the distance between their bases. Setae *le* frayed, on small apophyses; setae *in* setiform; both setae almost as long as *ro*. Sensilli third as long as *in*. One pair of alveolae *ex* visible.

Surface of notogastral plate covered with small pits and folds. With 12 frayed and phylliform notogastral setae, except setae *h1*, which are equal in width, with uneven margins. Setae *c1*, *c3*, *d1*, *d3*, *e* and *h2* half the length *f1*; *d2* third as long as *f1*. Setae *c2* quarter as long as *c1*, placed closer to *c1* than to *c3*. Setae *f2* shorter than *f1* but longer than *e2*. Setae *h1* almost three times longer than *f1*, with branched caves inside. Oval opening of opisthosomal gland (*gla*) situated below seta *f2*.

Pairs of epimeres medially separated. Epimeral setation: 2-1-2. Genital, aggenital and adanal plates, and anal setae lacking.

All legs monodactyrous (setation not studied).

**Protonymph** (Figures 18–29)

Body length: 470 µm, body width: 230 µm; colour: white, light brown

Setae *ro* as long as half of the distance between their bases. Setae *in* longer and broader than *ro*, notched. Sensilli 1.5 times longer than distance between their bases, slightly barbed and apically pointed. Setiform setae *ex* three times shorter than *ro*.

Surface of notogastral plate covered with small pits. With 16 frayed notogastral setae, except setae *h1*. Setae *c1*, *c3*, *d1*, *e*, *f1* and *h3* half shorter than *f2*. Setae *c2* shorter than *c3*, placed closer to *c1* than to *c3*. Setae *h1* as long as *f2*, with branched pits, set on apophyses. Setae *h2* as long as their mutual distance, apically narrowed, with branched pits. Setae *p1* as long as distance *p1–h2*, with branched caves inside, on apophyses. Setae *p2* longer than *h3*; *p3* similar to *ro*. Oval opening of opisthosomal gland (*gla*) situated near seta *f2*.

Pairs of epimeres separated. Epimeral setation: 2-3-3-(2,3). Genital plates with one pair of short setae. Aggenital, anal and adanal setae lacking.

All legs monodactylous (setation not studied).

**Deutonymph** (Figures 30–43)

Body length: 630 µm, body width: 310 µm; colour: light brown

Surface of prodorsum with small pits. Setae *ro* almost twice longer than distance between their bases. Setae *le* similar to *in*.

Setae *p2* as long as *h3*. Other notogastral setae similar to protonymphal setae. Oval opening of opisthosomal gland (*gla*) situated below seta *f2*.

Epimeral setation: 4-4-4-2 (hardly visible). Genital plates with four pairs of short setae; three pairs of adanal setae. Aggenital and anal setae lacking.

All legs monodactylous (setation not studied).
Figures 9–17. Nothrus glaesarius n. sp., larva. (9) Dorsal view. (10) Ventral view. (11) Seta c₁. (12) Seta c₂. (13) Seta c₃. (14) Seta f₁. (15) Seta f₂. (16) Seta h₂. (17) Seta h₁.
Figures 18–29. *Nothrus glaesarius* n. sp., protonymph. (18) Dorsal view. (19) Ventral view. (20) Fragment of prodorsum. (21) Seta $c_1$. (22) Seta $c_2$. (23) Seta $c_3$. (24) Seta $le$. (25) Seta $f_2$. (26) Seta $h_1$. (27) Seta $h_3$. (28) Seta $p_2$. (29) Seta $p_3$. 
Figures 30–43. *Nothrus glaesarius* n. sp., deutonymph. (30) Dorsal view. (31) Ventral view. (32) Seta $c_1$. (33) Seta $c_2$. (34) Seta $c_3$. (35) Seta $le$. (36) Seta $in$. (37) Seta $f_2$. (38) Seta $h_1$. (39) Seta $h_2$. (40) Seta $h_3$. (41) Seta $p_2$. (42) Seta $p_1$. (43) Seta $p_3$. 

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Tritonymph (Figures 44–53, 75–78)

Body length: 670 μm, body width: 320 μm; colour: light brown

Setae ro half shorter than distance between their bases. Setae le as long as ro. Setae in twice longer and broader than le. Setiform setae ex half shorter than ro.
With 16 frayed and narrower than deutonymphal notogastral setae. Setae $c_2$ as long as $le$, placed closer to $c_1$ than to $c_3$. Setae $h_3$ similar to $h_1$. Setae $p_1$ longer than distance $p_1$–$h_2$. Setae $p_2$ shorter than $c_2$; $p_3$ half shorter than $p_2$. Other notogastral setae similar to deutonymphal setae. Oval opening of opisthosomal gland (gla) situated below seta $f_2$. 

Figures 54–66. *Notthus glaesarius* n. sp., adult. (54) Dorsal view. (55) Fragment of epimera. (56) Fragment of prodorsum. (57) Tip of sensillus. (58) Posterior part of notogaster. (59) Posterior part of notogaster of paratype. (60) Seta $le$. (61) Seta $c_1$. (62) Seta $c_2$. (63) Seta $c_3$. (64) Seta $e_2$. (65) Seta $h_3$. (66) Seta $p_2$. 

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Figure 67. *Nothrus cotopaxiensis* n. sp., adult. General view.

Figure 68. *Nothrus cotopaxiensis* n. sp., adult. Dorsal view.
Epimeral setation: (6-7)-4-3-4. Genital plates with seven pairs of setae; two pairs of anal setae; three pairs of adanal setae.

All legs monodactylous (setation not studied).

**Adult** (Figures 54–66, 79–85)

Body length: 870–900μm (holotype: 880μm), body width: 450–480μm (holotype: 450μm); colour: amber brown.
Figure 71. Nothrus cotopaxiensis n. sp., adult. Seta $c_3$.

Figure 72. Nothrus cotopaxiensis n. sp., adult. Postero-lateral part of notogaster.
Setae \textit{ro} pointed distally, almost as long as their mutual distance. Setae \textit{le} and \textit{in} similar to \textit{ro} in length. Sensilli longer than distance between their bases, completely barbed, distally pointed. Setae \textit{ex} short, setiform.

Surface of notogastral plate covered with pits of different sizes. Shape of notogastral setae similar to tritonymphal setae. Setae \textit{c}_2 and \textit{c}_3 equally long, shorter than \textit{c}_1; \textit{c}_2 placed closer to \textit{c}_1 than to \textit{c}_3. Setae \textit{h}_1 almost twice longer than \textit{c}_3. Setae \textit{h}_2 almost as long as their mutual distance. Setae \textit{h}_3 similar to \textit{h}_1. Setae \textit{p}_1 as long as distance \textit{p}_1–\textit{h}_2.

Figure 73. \textit{Nothrus cotopaxiensis} n. sp., adult. Region of setae \textit{p}.

Figure 74. \textit{Nothrus cotopaxiensis} n. sp., adult. Tarsus with three claws.
Figure 75. *Nothrus glaesarius* n. sp., tritonymph. General view.

Figure 76. *Nothrus glaesarius* n. sp., tritonymph. Dorsal view.
Pairs of epimeres medially connected. Epimeral setation: 6-6-5-4. Genital plates with nine pairs of setae; two pairs of anal and three pairs of adanal setae. All legs tridactylous (setation not studied).

Figure 77. *Nothrus glaesarius* n. sp., tritonymph. Region of sensillus and setae $c$.

Figure 78. *Nothrus glaesarius* n. sp., tritonymph. Seta $in$. 
Remarks

The adult *Nothrus glaesarius* n. sp. is similar to the Japanese species *N. meakanensis* Fujikawa, 1999 and *N. silvestris* Nicolet, 1855. These species have similar notogastral setae and apically pointed, entirely barbed sensilli. *Nothrus glaesarius* differs from both species in...
its tridactylous tarsi, shorter sensilli and longer setae ro, le and shorter notogastral setae. However, the relationship of described species to bidactylous (but sometimes mono- or tridactylous) *N. silvestris* needs further study (Olszanowski 1996). Comparison of selected morphological characters of adults of the above-mentioned species is given in Table II.
Seniczak (1992) described the morphology of the larva and tritonymph of *N. silvestris*. Moreover, he also noted epimeral setation and body measurements of the other juvenile stages. An analysis of the ontogeny shows differences between *N. glaesarius* and *N. silvestris*, as indicated in Table III.

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**Figure 83.** *Nothrus glaesarius* n. sp., adult. Postero-lateral part of notogaster, dorsal view.

**Figure 84.** *Nothrus glaesarius* n. sp., adult. Postero-lateral part of notogaster, ventral view.
Etymology

The species name *glaesarius* refers to the amber brown body colour of the adult.

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| Character      | *N. glaesarius* n. sp. | *N. meakanensis* | *N. silvestris* |
|----------------|------------------------|------------------|-----------------|
| Body length    | 870–900 μm             | 807–1000 μm      | 710–810 μm      |
| Body width     | 450–480 μm             | 428–621 μm       | 350–430 μm      |
| Colour         | amber brown            | reddish brown    | brown to light brown |
| Number of claws| 3                      | 1                | 1 (2)           |
| Sensilli       | ss > (ss-ss)           | ss=2(ss-ss)      | ss > (ss-ss)    |
| Prodorsal setae| ro=le=in               | ro < le < in, in=3ro | ro=1/3 le, in=2ro |
| Setae *c*      | c₁ > c₂, c₂=c₃         | c₁=3c₂, c₃=2c₂   | c₁=3c₂, c₃=2c₂  |
| Setae *d*      | d₁=d₂=d₃              | d₁ > d₂ > d₃    | d₁ > d₂ > d₃   |
| Setae *e₁*     | e₁=d₁                 | e₁ > d₁         | e₁ > d₁        |
| Setae *h₂*     | the longest, shaped    | the longest, baciliform | the longest, baciliform |
| Epimera        | 6-6-5-4               | 5-3(4)-5-4(5)    | (6, 7)-(4, 5)-(5, 6)-(4, 6) |

Table II. Comparison of selected morphological characters of adults of *Nothrus glaesarius* n. sp., *N. meakanensis* and *N. silvestris* (based on Olszanowski 1996; Fujikawa 1999 and present studies).

Figure 85. *Nothrus glaesarius* n. sp., adult. Tarsus with three claws.
access to the specimens and the curator of the Basel Natural History Museum, Switzerland for the loan of material.

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References

Badejo MA, Woas S, Beck L. 2002. Description of six species of nothroid mites from Nigeria and Brazil (Acari: Oribatida: Nothroidae). Genus 13 (4):505–548.

Balogh P. 1988. Oribatid mites from Ecuador (Acari). Acta Zoologica Hungarica 34:321–338.

Balogh P. 1989. Oribatid mites from Ecuador (Acari) II. Acta Zoologica Hungarica 35:17–28.

Fujikawa T. 1999. Eight new species of the genus Nothrus. Edaphologia 63:5–54.

Kuty M. 2005. The morphology of juvenile stages of Crotonia pulcher (Beck, 1962) (Acari: Oribatida: Crotonioidea) with a redescription of the adult. Zoologischer Anzeiger 244:125–136.

Kuty M. 2006. A new species of the genus Holonothrus from Ecuador (Acari: Oribatida: Crotonioidea). Genus 17(2):307–310.

Nicolet H. 1855. Histoire naturelle des Acariens qui se trouvent aux environs de Paris. Archs Mus. Natn. Hist. Nat., Paris 7:318–482.

Olszanowski Z. 1996. A monograph of the Nothridae and Camisiidae of Poland (Acari: Oribatida: Crotonioidea). Genus – International Journal of Invertebrate Taxonomy, Wrocław. Supplement.

Schatz H. 1998. Oribatid mites of the Galapagos Islands – faunistics, ecology and speciation. Experimental and Applied Acarology 22:373–409.

Seniczak S. 1992. The morphology of juvenile stages of moss mites of the family Nothridae (Acari: Oribatida).II. Zoologischer Anzeiger 229 (3/4):149–162.

Subías LS. 2004. Listado Sistemático, Sinonímico Y Biogeográfico De Los Ácaros Oribatídos (Acariformes: Oribatida) Del Mundo (1758-2002). Graellsia, 60 (número extraordinario): 3–.

Travé J, Vachon M. 1975. François Grandjean. 1882-1975. (Notice biographique & bibliographique). Acarologia 17:1–19.

| Character                  | N. glaesarius n. sp. | N. silvestris |
|----------------------------|----------------------|--------------|
| LARVA                      |                      |              |
| Body length                | 380 µm               | 362 µm       |
| Body width                 | 190 µm               | 179 µm       |
| Prodorsal setae            | ro=le=in             | ro=2le, le=2in |
| Setae c                    | c₁=c₂, c₃=4c₂        | c₁>c₃, c₁=5c₂ |
| Setae d, e                 | central setae longer than lateral | similar in length |
| Setae h₁, f                | f₁>f₂, h₁=2 f₁, h₂=f₂ | f₁>f₂, h₁ = f₁, h₂=f₁ |
| Epimera                    | 2-1-2                | 2-1-2        |
| Body length                | 470 µm               | 402 µm       |
| Body width                 | 230 µm               | 203 µm       |
| PROTONYMPH                |                      |              |
| Body width                 | 310 µm               | 326 µm       |
| Epimera                    | 2-3-3-(2, 3)         | 3-2-3-0      |
| Body length                | 670 µm               | 618 µm       |
| Body width                 | 320 µm               | 335 µm       |
| DEUTONYMPH                |                      |              |
| Body length                | 630 µm               | 549 µm       |
| Epimera                    | 4-4-4-2              | 5-3-4-2      |
| Body length                | 670 µm               | 618 µm       |
| Body width                 | 320 µm               | 335 µm       |
| TRITONYMPH                |                      |              |
| Prodorsal setae            | ro=le, in=2le        | ro=le, in>le |
| Setae c                    | c₁>c₃, c₂=c₃         | c₁>c₃, c₂=½ c₃ |
| Setae h₁, p                | p₁=2h₁              | p₁<h₁        |
| Epimera                    | (6, 7)-4-3-4        | 6-4-5-4      |