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LARDOGlyphus falconidus n. sp.
(Acarina : Acaridae) FROM THE NEST
OF AN AMERICAN KESTREL (Falco sparverius L.)

by

J. R. PHILIPS ¹ and R. A. NORTON ²

ABSTRACT

Lardoglyphus falconidus n. sp. (Acarina : Acaridae) is described from an American kestrel (Falco sparverius L.) nest in central New York. The biology of Lardoglyphus is briefly discussed and a key to the described species is presented.

RÉSUMÉ

Description de Lardoglyphus falconidus n. sp. du nid d’une crécerelle Américaine (Falco sparverius L.) du centre de l’État de New York.
Présentation d’une clé des espèces décrites du genre Lardoglyphus, et discussion de sa biologie.

The genus Lardoglyphus was established by Oudemans (1927) for L. zacheri, first found in a culture of the beetle Dermestes lardarius L. on hides in South America. Hughes (1956) provided a more complete description of L. zacheri. A second species, L. konoi (Sasa and Asanuma, 1951), is of economic importance. It was first found on dried fish in Japan, and later (Hughes, 1956) on dried seafood in India. Vijayambika and John (1973, 1974b, 1975a, b, c) have examined its internal morphology and histology. Fain and Caceres (1973) described another species, L. angolensis, from hypopi found on an otter shrew, Potamogale volox. A fourth species, undescribed and also known only from the hypopus, was found by Radosvky (1970) on fecal material found in a human mummy in Nevada.

Hughes (1961) reviewed the main characteristics of the genus. The claws of all legs are bifid in the female. The chaetotaxy of the dorsal and lateral surfaces of the idiosoma is complete. Setae ve are finely pectinate and arise at the same level as vi. Setae sce are longer than sci. None of the dorsal leg setae are thickened as spines. Only heteromorphic males are formed and there is no posteriorly projecting opisthosomal plate.

In the following description, Hughes’ (1961) terminology is followed except where noted. All measurements are given in micrometers (μm) and represent ranges or averages from 10 specimens. Claws and pretarsi are excluded from tarsal length measurements. Femoral measurements include sections inserted in the trochanter.

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Lardoglyphus faloonidus n. sp.

**Female**

Length of idiosoma 384-447; greatest width 239-306. Body widest between second and third pairs of legs; posteriorly shallowly bilobed (Fig. 1A). Dorsal and ventral surfaces mostly striate; posterodorsal region spiny, not striate. Spines smaller, rounded and scale-like on lateral and anterior portions of opisthosoma. Three pairs of opisthosomal cupules (ia, im, ip) ¹. Latero-opisthosomal gland (gla) opens between la and lp. Idiosomal setae finely barbed. Propodosomal-opisthosomal groove indistinct, indicated by changes in pattern of striation. Lengths of setae: vi 88-104; ve 60-92; sci 81-111; sce 116-156; d₁ 144-178; d₂ 156-197; d₃ 120-172; d₄ 185-219; hi 85-124; he 127-177; hv 61-80; la 145-179; lp 122-168; sai 179-220, sae 117-164.

Ventrally, two pairs of coxal setae, three pairs of genital setae, five pairs of anal setae (a₁ 26-32; a₂ 33-43; a₃ 60-80; a₄ 16-28; a₅ 12-26) and two pairs of postanals (pa₁ 109-159; pa₂ 187-224). Bursa copulatrix opening posteroventrally.

Gnathosoma slender. Chelicerae 69-82; fixed digit with one large tooth; movable digit with one very small tooth.

Legs long and slender, with well developed pretarsi and bifid claws. Leg segment lengths given in Table 1. Setation given in Table 2. Solenidion Ω 2.5 times the length of Ω₂. Famulus (Fig. 1B) short, partially sunken in integument, distally rounded, dorsoventrally flattened. Solenidion ø long, whiplike; solenidion σ₁ about five times longer than σ₂. Supracoxal seta tapering, finely barbed, length 38-47.

**Male**

Length of idiosoma 325-381; greatest width 192-235. Idiosomal shape similar to female except rounded posteriorly (Fig. 2A). Idiosoma with dorsal and ventral striations but without spines or scales. Posterior dorsal and ventral hysterosoma smooth. Idiosomal setae and cupules as in female. Setal lengths: vi 54-81; ve 53-66; sci 59-83; sce 96-127; d₁ 108-156; d₂ 110-180; d₃ 83-142; d₄ 125-177; hi 65-94; he 104-140; hv 50-70; la 104-148; lp 87-135; sai 134-176; sae 86-129.

Ventrally, with two pairs of coxal setae and three pairs of genital setae. Anal setae anterior to anal suckers (Fig. 2B), bifid (Fig. 2C), length 10-16. Three pairs of postanal setae: pa₁ 30-45; pa₂ 59-92; pa₃ 119-166. Aedeagus between coxae IV.

Gnathosoma and chelicerae as in female. Cheliceral length 53-67.

Legs (Tables 1, 2) terminating in a single claw which is modified on leg III (Fig. 2D). Setae r and s spinose on legs III and IV. Leg IV (Fig. 2E) with two setae replaced by suckers in the distal half of the tarsus. Supracoxal seta as in female, length 31-37.

**Hypopus**

Length of idiosoma 217-252; greatest width 171-198. Idiosoma rounded (Fig. 3A). Propodosomal and hysterosomal shields reticulate, punctate as in other species of the genus. Lengths

¹. These cupules are homologous to those described by Grandjean (1933) for oribatid mites. Hughes (1961) used the term “chitinous rings” for these structures.

_Acarologia_, t. XX, fasc. 1, 1978.
Fig. 1. — A. *Lardoglyphus falconidus* n. sp. Female dorsal aspect. B. famulus, *L. falconidus*. C. famulus, *L. zacheri* and *L. konoi*. 
Fig. 3. — *Lardoglyphus falconidus*, n. sp. hypopus. A. dorsal aspect. 
F. paddle-like tarsal seta.
of propodosomal setae: \(vi\) 18-22; \(ve\) 8-11; \(sci\) 11-13; \(sce\) 13-17. Setae of the \(d\) series ranging from thin and setiform (\(d_1\), Fig. 3B) to thicker spines (\(d_3\), \(d_4\)). Seta \(hv\) laterally inserted. Lengths of hysterosomal setae: \(d_1\) 9-12; \(d_2\) 7-9; \(d_3\) 8-11; \(d_4\) 8-11; \(hi\) 11-17; \(he\) 8-15; \(hv\) 13-15; \(la\) 10-13; \(lp\) 10-12; \(sai\) 15-21; \(sae\) 5-8.

Ventral surface smooth. Epimeres I unite to form a short sternum. Epimeres II-IV free. Three pairs of chitinous rings; one pair on coxal fields I and III, and one pair between coxae II and III. A pair of setae present between coxae II and III and a pair between coxae IV. Anal setae (\(a\)) bifid (Fig. 3C), length 8-9.

Sucker plate (Fig. 3C) with a hyaline margin; two large central suckers, two anterior, four posterior and two lateral. Length of sucker plate 48-56; width 66-77. Two ridged horns lateral to central suckers as in \(L. konoi\). Central sucker width 10-11; anterior suckers sometimes asymmetrical, width 5-9.

Gnathosoma (Fig. 3D) divided distally, with two pairs of setae. Length of apical solenidion \(\omega\) 27-32.

Legs I-III with a single claw; leg IV clawless but terminating in two long flagellate setae. Segment lengths and chaetotaxy given in Tables 1, 2. Tarsi I and II with five leaf-like setae (Fig. 3E). Tarsus III with seven widened setae, ranging from leaf-like to paddle-like (Fig. 3F). Tarsus IV with three paddle-like setae.

**Protonymph**

Length of idiosoma 203-298; greatest width 130-159. Body oval, striate. Idiosomal setae as in adult, lengths: \(vi\) 31-38; \(ve\) 21-27; \(sci\) 24-34; \(sce\) 57-76; \(d_1\) 39-58; \(d_2\) 40-74; \(d_3\) 25-47; \(d_4\) 38-59; \(hi\) 24-43; \(he\) 40-57; \(hv\) 19-23; \(la\) 43-57; \(lp\) 27-40; \(sai\) 48-65; \(sae\) 16-26. Chelicerae as in adult, length 41-51. Leg setation and segment lengths in Tables 1, 2. Legs I-IV monodactyl. Supracoxal seta as in adults, length 21-23.

**Larva**

Length of idiosoma 141-177; greatest width 89-116. Body oval, striate. Odiosomal setae lengths: \(vi\) 21-26; \(ve\) 7-13, \(sci\) 12-20; \(sce\) 37-48; \(d_1\) 14-20; \(d_2\) 13-21; \(d_3\) 14-20; \(d_4\) 17-27; \(hi\) 11-14; \(he\) 14-21; \(hv\) 8-12; \(la\) 12-17; \(lp\) 11-14. Chelicerae as in adults, length 31-40. Legs I-III monodactyl. Leg setation and segment lengths in Tables 1, 2. Supracoxal seta as in adults, length 11-14. Leg IV absent.

**Egg**


**Remarks**

The spiny opisthosoma readily distinguishes females of this species from its congeners. The striations are also apparently unique to the adults of this species. Descriptions of \(L. zacheri\) and \(L. konoi\) both state that the skin is smooth in both sexes. We have examined females of both species and males of \(L. zacheri\) and found no striations.

The famulus is quite distinct from that of \(L. zacheri\) and \(L. konoi\) in all stages. It is long and tapering in the latter two species (Fig. 1C).
### TABLE 1: Mean Leg Segment Lengths (in μm)
of *Lardoglyphus falconidus*

<table>
<thead>
<tr>
<th>Developmental Stage</th>
<th>Leg</th>
<th>Tarsus</th>
<th>Tibia</th>
<th>Genu</th>
<th>Femur</th>
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<td>20</td>
<td>13</td>
<td>12</td>
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<td>19</td>
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<tr>
<td></td>
<td>III</td>
<td>23</td>
<td>13</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>protonymph</td>
<td>I</td>
<td>26</td>
<td>18</td>
<td>18</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>27</td>
<td>17</td>
<td>17</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>27</td>
<td>16</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>34</td>
<td>18</td>
<td>15</td>
<td>18</td>
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<tr>
<td>hypopus</td>
<td>I</td>
<td>40</td>
<td>23</td>
<td>21</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>39</td>
<td>22</td>
<td>20</td>
<td>28</td>
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<tr>
<td></td>
<td>III</td>
<td>22</td>
<td>17</td>
<td>15</td>
<td>24</td>
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<td></td>
<td>IV</td>
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<td>22</td>
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<td>34</td>
<td>35</td>
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<td></td>
<td>II</td>
<td>57</td>
<td>34</td>
<td>35</td>
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<td>88</td>
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<td>36</td>
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<td>44</td>
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<td></td>
<td>III</td>
<td>38</td>
<td>44</td>
<td>37</td>
<td>43</td>
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<tr>
<td></td>
<td>IV</td>
<td>40</td>
<td>43</td>
<td>39</td>
<td>46</td>
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</tbody>
</table>

### TABLE 2: Leg Setation of described species of *Lardoglyphus* (tarsus to trochanter, famulus not included)

<table>
<thead>
<tr>
<th>Species</th>
<th>Stage</th>
<th>Leg I</th>
<th>Leg II</th>
<th>Leg III</th>
<th>Leg IV</th>
</tr>
</thead>
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<td>larva</td>
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<td>10-2-2-1-0</td>
<td>8-1-1-0-0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>protonymph</td>
<td>10-2-2-1-0</td>
<td>10-2-2-1-0</td>
<td>8-1-1-0-0</td>
<td>5-0-0-0-0</td>
</tr>
<tr>
<td></td>
<td>hypopus</td>
<td>9-2-2-1-1</td>
<td>9-2-2-1-1</td>
<td>8-1-1-0-1</td>
<td>8-1-0-1-0</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>11-2-2-1-1</td>
<td>10-2-2-1-1</td>
<td>8-1-1-0-1</td>
<td>8-1-0-1-0</td>
</tr>
<tr>
<td></td>
<td>male</td>
<td>11-2-2-1-1</td>
<td>10-2-2-1-1</td>
<td>8-1-1-0-1</td>
<td>8-1-0-1-0</td>
</tr>
<tr>
<td><em>L. zacheri</em></td>
<td>protonymph</td>
<td>11-2-2-1-0</td>
<td>10-2-2-1-0</td>
<td>8-1-1-0-0</td>
<td>5-0-0-0-0</td>
</tr>
<tr>
<td></td>
<td>hypopus</td>
<td>9-2-2-1-1</td>
<td>9-2-2-1-1</td>
<td>8-1-1-0-1</td>
<td>8-1-0-1-0</td>
</tr>
<tr>
<td></td>
<td>male</td>
<td>11-2-2-1-1</td>
<td>10-2-2-1-1</td>
<td>8-1-1-0-1</td>
<td>6-1-0-1-0</td>
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<tr>
<td></td>
<td>female</td>
<td>11-2-2-1-1</td>
<td>10-2-2-1-1</td>
<td>8-1-1-0-1</td>
<td>8-1-0-1-0</td>
</tr>
<tr>
<td><em>L. konoi</em></td>
<td>female</td>
<td>9-2-2-1-1</td>
<td>8-2-2-1-1</td>
<td>6-1-1-0-1</td>
<td>6-1-0-1-0</td>
</tr>
</tbody>
</table>
In the male, the bifid anal setae are distinctive, as well as legs III and IV. There is some confusion in the literature regarding the claw and spine-like structures on tarsus III. Sasa and Asuma (1951) stated that tarsus III had two separate terminal claws in L. konoi. According to Hughes (1956), the ambulacrum of leg III is replaced by two spine-like structures in L. zacheri. We examined males of L. zacheri under polarized light and found that the larger spine is derived from the claw; the smaller spine is a hypertrophied seta. This is the case in all three species of Lardoglyphus. In L. falconidus, the larger spine is curved and more claw-like than in the other two species, and seta is a much smaller spine. On tarsi III and IV, seta is a wider, shorter spine than in the other two species. The suckers of tarsus IV are more distally placed in L. falconidus than in L. zacheri and L. konoi.

The hypopus also possesses distinctive bifid anal setae. We have examined many hypopi and only found one in which these setae were not bifid. In that case, the setae were each trifid, with a very thin central branch. The tarsal setae also differentiate this hypopus from the other species. L. zacheri has none which are leaf-or paddle-like. L. konoi has only one leaf-like seta (f) on tarsi I and II, and only two paddle-like setae on tarsus IV.

**Type material**

Type series from the nest of an American kestrel (Falco sparverius L.), Jamesville, N.Y., 24 June 76, collected by J. R. Philips. Holotype female, allotype male, and paratype hypopus, protonymph and larva deposited in the United States National Museum (Washington, D.C.). Paratypes deposited at the Harvard Museum of Comparative Zoology (Cambridge, Mass.), the Acarology Laboratory (Columbus, Ohio), the Hungarian Natural History Museum (Budapest) and the Prince Leopold Institute for Tropical Medicine (Antwerp).

**Keys to the described species of LARDOGLYPHUS**

(modified from Hughes, 1961)

**Females**

1. Dorsal opisthosoma striate, with spines and scales.................. falconidus n. sp.
   Dorsal opisthosoma smooth.................................................. 2
2. Setae d4 approximately equal to d3........................................ konoi (S. & A.)
   Setae d4 longer than twice d3............................................ zacheri Ouds.

**Males**

1. Legs I and II with bifid claws............................................. zacheri Ouds.
   Legs I and II with undivided claws........................................ 2
2. Anal setae bifid, anterior idiosoma striate.......................... falconidus n. sp.
   Anal setae simple, anterior idiosoma smooth............................ konoi (S. & A.)

**Hypopi**

1. No leaf-like tarsal setae.................................................. zacheri Ouds.
   Some leaf-like tarsal setae................................................ 2
2. Anal setae bifid.............................................................. falconidus n. sp.
   Anal setae simple.................................................................... 3
Biology of Lardoglyphus Species

According to Hughes (1956) the life cycles of L. zacheri and L. konoi may be completed in 10-11 days at 23°C. Both species possess a tritonymph stage, and neither is parthenogenetic. No tritonymphs of L. jalconidus have been found, and this stage appears to be lacking in this species.

Hughes cultured L. zacheri and L. konoi on dried heart muscle, whereas Vijayambika and John (1974a) cultured L. konoi on dried anchovy. L. konoi has been collected from butchers' offal, dried fish and dried shellfish, while L. zacheri is known from butchers' offal, bones, hides and sheepskin (Hughes, 1961). Radovsky's undescribed species represents an additional carrion record.

L. jalconidus was collected from a nest-box 6 m high in a dead tree. The kestrels fledged four young (D. Crumb, pers. comm.) and the nest was collected the day after the last young left the nest. The nest was composed mainly of small bits of grass, wood, and leaves, with sawdust. Eggshell fragments, excreta and a few bones and feathers were present, as well as some regurgitated pellets consisting mainly of indigestible hair and chitin from prey. A pellet sample, extracted separately from other nest material in Tullgren funnels, also contained many specimens of L. jalconidus.

The nest material weighed 705 g dry weight; water content was 28% of dry weight. We estimated the total nest population of L. jalconidus to be in excess of 8,000, in the following proportions: larvae 8%, protonymphs 39%; hypopi 41%; males 5%; females 7%. Among females, 14% contained three eggs, 37% contained two eggs, 26% contained one egg, and 23% contained no eggs. We have observed fungal spores (probably Aspergillus sp.) in the guts of all feeding stages.

L. jalconidus was by far the numerically dominant mite in this nest. It likely served as prey for such predators as Staphylinidae, Histeridae, Cheyletus trouessarti Ouds., Macrocheles muscae-domesticae (Scopoli), Dendrolaelaps sp. and Poecilochirus necrophori Vitzthum, also found in this nest. None of the above predators have previously been reported from American kestrel nests (Hicks, 1959, 1962, 1971).

Hughes (1956, 1961) found that food shortage caused hypopus formation in L. zacheri. In contrast, Vijayambika and John (1974a) found that overcrowding and food scarcity were not responsible for hypopus formation in this species. In addition, no significant correlations were found between humidity, temperature and counts of hypopi. They believed that the ability of protonymphs to transform to deutonymphs may be hormone-controlled.

Hypopii of L. zacheri are known to be phoretic on larvae of Dermestes maculatus DeGeer, D. lar-darius L., D. frischii Kugelann, and Necrobia rufipes DeGeer, and even adults of their own species (Hughes, 1956). Hughes isolated a dermestid larva carrying 25 hypopi; nymphs appeared in three days, but one hypopus remained attached for 13 days. Hypopi showed no inclination to attach to dermestid adults, although they would seem to be far more effective dispersal hosts. Sasai and Asanuma (1951) found L. konoi hypopii attached to hairs of larvae of Dermestes sp. We have found hypopii of L. jalconidus attached to the abdomen and thorax of larvae of Dermestes pulcher Lec. from the nest. Up to 21 hypopi per larva were attached mainly at inter-segmental crevices and skin folds.
Balgooeyen (1976) found dermestid beetles, usually in high numbers, in every kestrel nest he examined in the Sierra Nevadas. More nests of kestrels and other birds need to be examined to determine the distribution of *L. falconidus* and whether it uses adult dermestids as a dispersal agent for nest colonization.

**Acknowledgements**

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