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Pterostichus (*Anilloferonia*) *diana* LaBonte (Coleoptera: Carabidae: Pterostichini), a replacement name for *P.* (*A.*) *lanei* (Hatch, 1935), and validity and redescription of *P.* (*A.*) *malkini* (Hatch, 1953)

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Abstract

A replacement name for *Pterostichus* (*Anilloferonia*) *lanei* (Hatch), 1935, is necessary because *P. lanei* (Hatch) is a secondary homonym of *P.* (*Pseudoferonina*) *lanei* Van Dyke, 1925. I have selected *P.* (*A.*) *diana* as this replacement name. *Pterostichus* (*Anilloferonia*) *malkini* (Hatch), 1953, was described from a single female collected in 1951. Since then five more specimens have been collected, including males. Based on this additional material it is clear this species is valid, which had been uncertain. Since the original description of *P. malkini* did not include male characteristics, several of which are diagnostic, a detailed description of this species is provided. Locality and habitat details for this rarely collected species are included. Characters differentiating *P. malkini* from the other species of *P.* (*Anilloferonia*) are illustrated and discussed.

Key words: ground beetle, microphthalmous, Oregon, endogean

Introduction

The genus *Anilloferonia* was erected by E.C. Van Dyke in 1926 to accommodate the first described microphthalmous North American pterostichine, *Anilloferonia testacea* Van Dyke, 1926 (Van Dyke 1926). Additional species were subsequently described within this genus by Melville H. Hatch, including *A. lanei* Hatch, 1935; *A. rothi* Hatch, 1951; and, finally, *A. malkini* Hatch, 1953 (Hatch 1935, 1951, 1953).

Members of *Anilloferonia* have since been placed within the *amethystinus* species group of *Pterostichus* Bonelli (Bousquet and Larochelle 1983) or, more or less equivalently, within the subgenus *Hypherpes* Chaudoir (Ball and Bousquet 2001). Based on DNA analysis, a recent phylogeny supports *Anilloferonia* (comprised of *P. lanei*, *P. malkini*, and *P. testacea*) as a valid subgenus (Will and Gill 2008). This same paper concludes that *P. rothi* is actually a member of the subgenus *Leptoferonia* Casey, 1918. The recognition of *Anilloferonia* as a subgenus of *Pterostichus* creates a nomenclatural problem explicitly acknowledged by Bousquet (2012, p. 832): *P.* (*A.*) *lanei* (Hatch) becomes a secondary homonym of *P.* (*Pseudoferonina*) *lanei* Van Dyke, 1925. Hence, a replacement name is necessary. I will provide such a replacement name in this paper.

The characters differentiating *P. lanei* (Hatch) and *P. malkini* in Hatch (1953) were subtle at best and some were invalid. Based on my examination in the 1990's of the sole available specimen of *P. malkini*, the female holotype, I felt the specimen merely represented a variant population at the southernmost portion of the known range of beetles which are, after all, soil-dwelling and flightless. Such species often exhibit substantial morphological variation among populations and this variation is often most pronounced at the range extremes.

Uncurated and recently collected material in my own collection included five specimens of *P. malkini*, including males (Fig. 1). Subsequent examination of these additional specimens, along with numerous southern specimens of *P. lanei* (Hatch), revealed clear and consistent species-specific characters for *P. malkini*, establishing its validity. In this paper, I indicate those characters most readily distinguishing *P. malkini* from the other species of *P.* (*Anilloferonia*). Furthermore, since the description of *P. malkini* (Hatch 1953, p. 119) consists only of five lines and forty-five words and does not address male characters, I will describe this species more completely.

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Methods

Specimens I identified as *P. malkini* were compared to the holotype to ensure they were conspecific. All known specimens of *P. malkini* (n = 6: three females and three males) were then used to develop a composite description. These specimens were compared to all specimens of the other species of *P.* (*Anilloferonia*) (excluding *P. rothi*) readily available to me. Images used in this paper were acquired via the imaging system at the Oregon Department of Agriculture. The core components of this system are a Visionary Digital™ imaging system and a digital Canon 7D single lens reflex camera. Images were processed with Zerene™ Stacker using the PMax algorithm. Specimens were scrutinized under several binocular dissecting microscopes, up to 160X. Measurements were acquired via a micrometer disc.

Replacement name for *Pterostichus* (*Anilloferonia*) *lanei* Hatch

I have selected *P. diana* LaBonte as the replacement name for *P. lanei* (Hatch). The specific cognomen is a noun in apposition and is the first name of my wife, Diana N. Kimberling.

FIGURE 1. Habitus of male *Pterostichus* (*Anilloferonia*) *malkini* (Hatch).

Redescription of *Pterostichus* (*Anilloferonia*) *malkini* (Hatch)

(Fig.1)

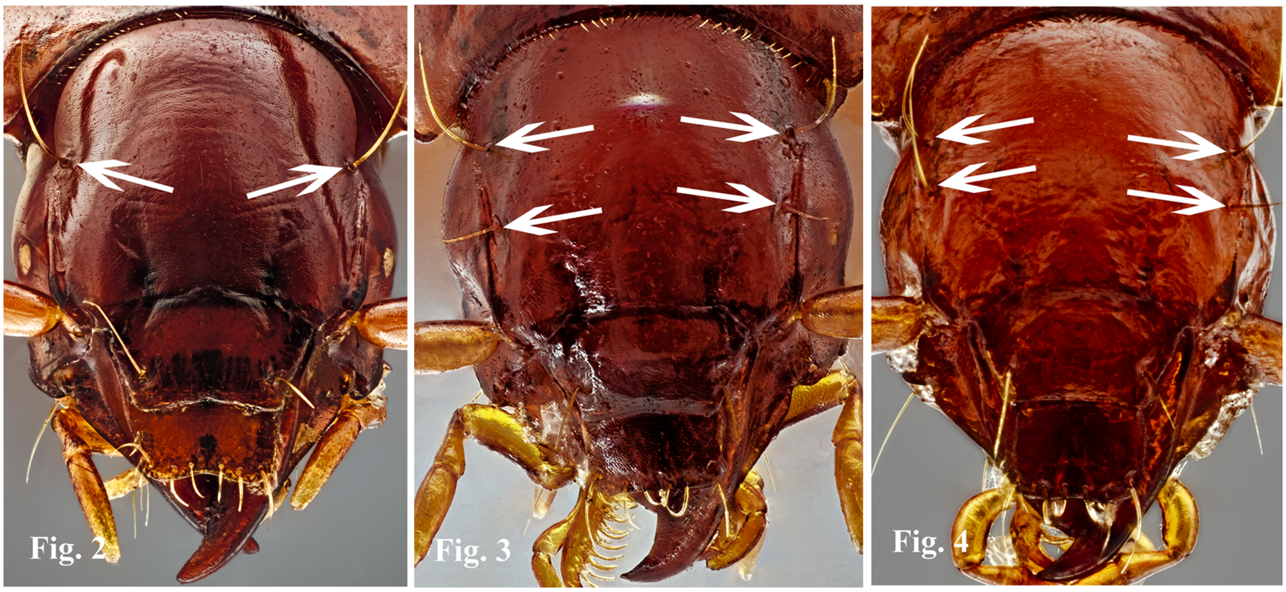
Color: Rufous to dark rufous throughout. **Total body length** (mandible apices to occiput + middle of pronotum from anterior margin to posterior margin + base of scutellum along suture to elytral apex): 6.2–7.8 mm. **Head**: Mandibles elongate, with sharp, hooked apices. Frontolateral carinae distinct, well-defined, parallel except anterior of antennal insertions, where each forms an arcuate obtuse angle with the medially directed anteriormost portion; each extending from frontoclypeal suture to supraorbital seta and highest at antennal insertion. Each frontal impression distinct and deeply impressed, extending from posterior half of clypeus about halfway to occiput, straight on posterior half of clypeus and then arcing from antennal insertion mediad, becoming arcuately divergent at posterior extent. Moderately wide, at widest point 0.6–0.7 as wide as widest point of pronotum. Antennae extending about two segments beyond posterior margin of pronotum. Eyes minute, 0.07–0.125 mm long at greatest length, narrowly ovate and from 0.05–0.075 mm wide, facets faintly visible. One pair of supraborbital setae, anterior pair absent. **Pronotum**: Greatest width 1.1 times greater than length along midline, greatest width about 0.7 of total length from posterior margin, just posterior of anterolateral setae. Anterior angles distinctly protruding beyond truncate anteromedial margin, narrowly rounded at approximate acute angle. Anterolateral setae about 0.75 of total length from posterior margin and adjacent to lateral margin. Lateral margins evenly slightly convex from anterior angles to about midlength of pronotum, thereafter straight and slightly convergent to posterior angles (varying to faintly sinuate at about anterior limits of posterlateral depresssions and parallel just anterior of posterior angles). Posterior angles about 90^0 or narrowly obtuse, narrowly rounded. Posterolateral setae in posterior angles, about twice distance from lateral margins as posterior margin. Posterior margin faintly convex laterad of each posterolateral impression, faintly emarginotruncate between impressions. Lateral explanations more or less evenly narrow from anterior angles to anterolateral setae, then gradually broadening to about anterior limits of posterolateral impressions, rapidly broadening thereafter until reaching posterior margin. Anteromedial impression at most very faint, indicated by row of shallow, large punctures. Median line strongly impressed, extending from about anteromedial impression to just anterior of or reaching posterior margin. Dorsal surface shallowly evenly convex either side of median line to about 0.6 distance to lateral margin, somewhat flattened laterad from there. Posterolateral impressions linear, deeply incised. Dorsal surface between median line and impressions somewhat flattened, but tumid compared to flat or faintly concave areas laterad of impressions. Impressions extend 0.3–0.4 total pronotal length from posterior margin. Areas between median line and impressions with sparsely to moderately dense fine and coarse deep punctures, areas laterad of impressions with sparse fine shallow punctures, sometimes virtually impunctate. Posterior margin with complete marginal bead. **Elytra**: Total length about 1.7 times combined greatest width of elytra. Anterior margins slightly concave. Humeral teeth from very small and barely visible to sharp and distinct. Expression of parascutellar striae and angular bases of striae 1 highly variable among specimens, including asymmetrical expression in some individuals. Parascutellar stria may coalesce with stria 1, be distinct but not coalescent with stria 1, or be intermittent and not coalescent with stria 1. Angular base of stria 1 may coalesce with stria 1 or be discontinuous with the anterior portion of stria 1. No basal punctures or setae are present. Striae with faint, evenly spaced, elongate punctures. Epipleuron with distinct, narrow, preapical plica, not denticulate at plica. Umbiculate series of stria 8 with five setiferous punctures in anterior series, one at about anterior third, a pair behind middle, a triad anterior of plica. A pair of subapical umbiculate setiferous punctures in stria 7 posterior of plica. **Ventral thoracic sclerites**: Prosternal process varying from faintly to strongly margined. Prosternum impunctate except for variable scattered coarse, deep punctures along lateral portions. Proepisterna with moderately dense coarse, deep punctures concentrated in anterior 2/3. Mesosternum impunctate. Mesoepisterna with dense coarse, deep punctures, most in anterior half along mesepisternal depression. Metasternum impunctate except along lateral portions, which have moderately dense coarse, deep punctures. Metaepisterna with variably distributed scattered coarse, deep punctures. **Abdominal ventrites**: Ventrites 1 and 4–6 impunctate. Ventrites 2 and 3 with variable scattered punctures about midway between median and lateral margins. Ventrites 3–5 with a pair of paramedial setae. Female ventrite 6 with two pairs of apical paramedial setae. Male ventrite 6 with a single pair of apical paramedial setae. Male ventrite 6 with a low, vertically directed lobe between the setae and just anterior of posterior margin, this lobe broadly truncate when viewed from purely anterior or posterior perspectives. Female ventrite 6 without a lobe, but with a very small tumidity between the median pair of paramedial setae. **Legs**: Female protarsomeres 2–4 broadly triangular and lacking ventral squamose setae, protarsomeres 1 and 5 moderately elongate, 5 glabrous ventrally. Male protarsomeres 1 moderately elongate and expanded in apical half, 2–4 larger and broader than in female, 5 as in female; ventral squamose setae on expanded portion of 1 and 2–3, 4 and 5 lacking such setae. Mesotarsomeres 2–4 in both females and males somewhat short and broad, rest moderately elongate. Metatarsomeres in both females and males moderately elongate. Metatrochanters slender and cylindrical, narrowly rounded at apex. Female metafemora slender, more or less cylindrical, ventral margin smooth and shallowly, evenly convex. Female metatibiae straight in dorsal view.

Male metafemora flattened and broadest in anterior and posterior views, with distinct obtuse angle at about 2/3 along ventral margin from femoral base, femoral base about 1/4 as wide and apex about half as wide as at angle; ventral face with very well defined carinae on either side extending from angle to apex and delimiting a concavity, carinae merging medially at angle to form interior delimitation of concavity. Male metatibiae slightly arcuate in dorsal view. **Aedeagus**: In lateral view, ventral margin of median lobe meets base at right angle. Right medioventral tumidity of median lobe very small, near base, thus in lateral view ventral margin of median lobe unisinuate with a single concavity near apical third. In dorsal view, tip of median lobe very short, rounded at apex, strongly convex at right extreme and straight along entire apical half of median lobe. Internal sac with a single large, slender sclerotized spine.

Distinguishing *Pterostichus malkini* from other species of *P.* (*Anilloferonia*)

Four characters readily distinguish *P. malkini* from *P. diana* and *P. testacea*: the number of supraorbital setae, the shape of the male metafemur, the form of the last visible abdominal ventrite of the male just anterior of the apical margin, and the form of the median lobe of the aedeagus. There are other distinguishing characters but these are subtle, are often variable, and sometimes cannot be accurately assessed without access to reliably identified reference specimens. They will not be addressed herein as that would be more appropriate in a broader treatment of *Anilloferonia*.

All known specimens (6) of *P. malkini* have only one pair of supraorbital setae (Figure 2). All specimens of *P. diana* (111) (Figure 3) and *P. testacea* (21) (Figure 4) I examined have two pairs of supraorbital setae, with the exception of one specimen of *P. diana* with two setae on one side and three on the other.

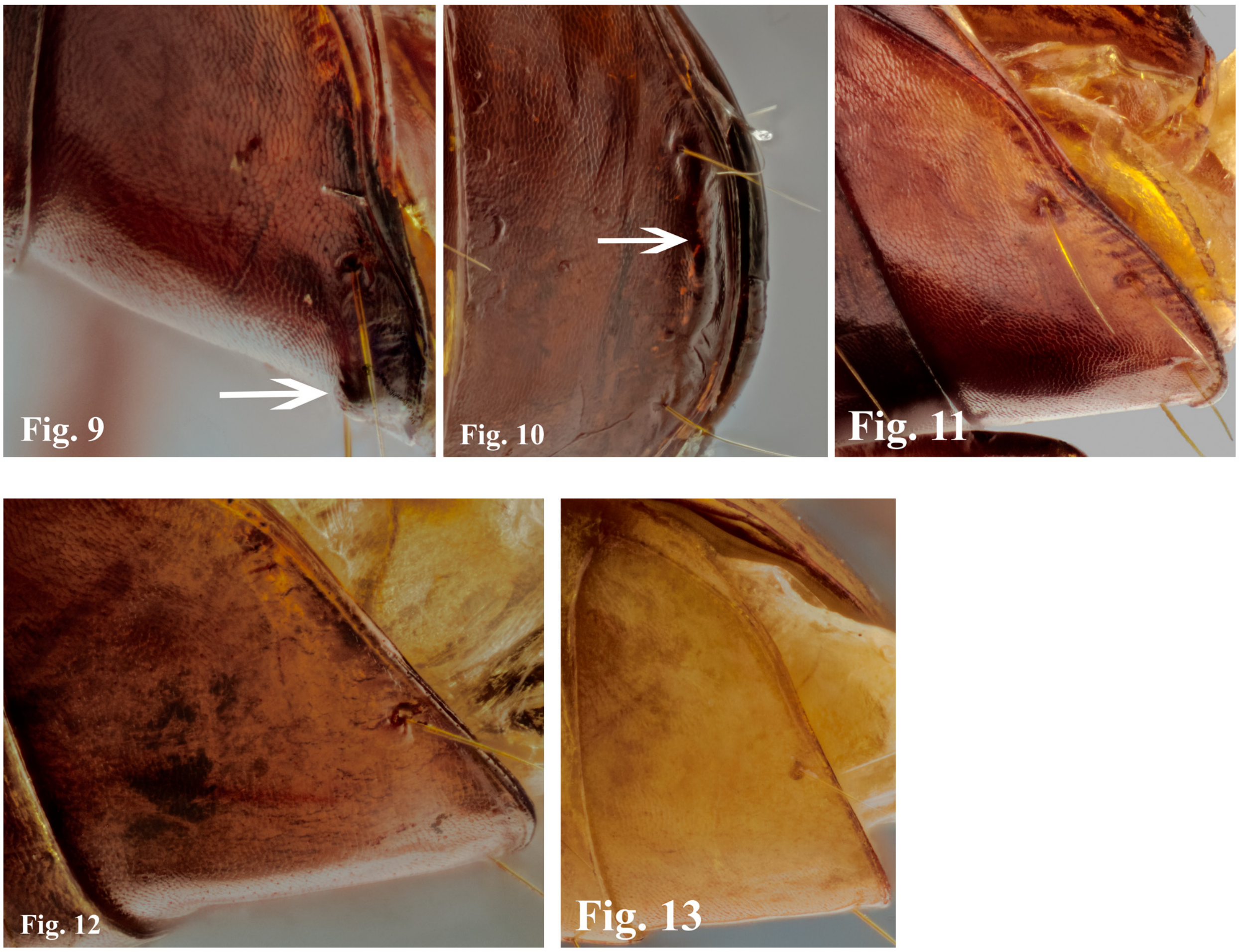


FIGURES 2–4. Supraorbital setae of species of *Pterostichus* (*Anilloferonia*). Figure 2, *P. malkini*. Figure 3, *P. diana*. Figure 4, *P. testacea*.

The median posterior margins of the metafemora of the three male *P. malkini* examined are obliquely angulate and the ventral faces of the metafemora are broader at that point than at either end (Figure 5). The posterior margins of the metafemora of female *P. malkini* (Figure 6) and both females and males of *P. diana* (male, Figure 7) and *P. testacea* (male, Figure 8) are shallowly, smoothly arcuate throughout and the metafemora are more or less narrowly cylindrical throughout.

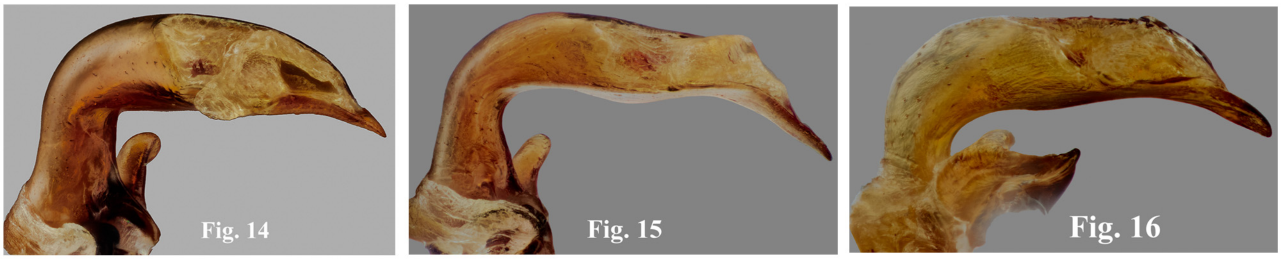
FIGURES 5–8. Metafemora of species of *Pterostichus* (*Anilloferonia*). Figure 5, male *P. malkini*. Figure 6, female *P. malkini*. Figure 7, male *P. diana*. Figure 8, male *P. testacea*.

The last abdominal ventrite in the three available specimens of male *P. malkini* has a small, ventrally projecting ridge between the pair of paramedial preapical setae (Figures 9–10). Female *P. malkini* lack this ridge (Figure 11), although a small preapical protuberance is present. The last abdominal ventrites of females and males of *P. diana* (male, Figure 12) and *P. testacea* (male, Figure 13) lack preapical ridges or protuberances.



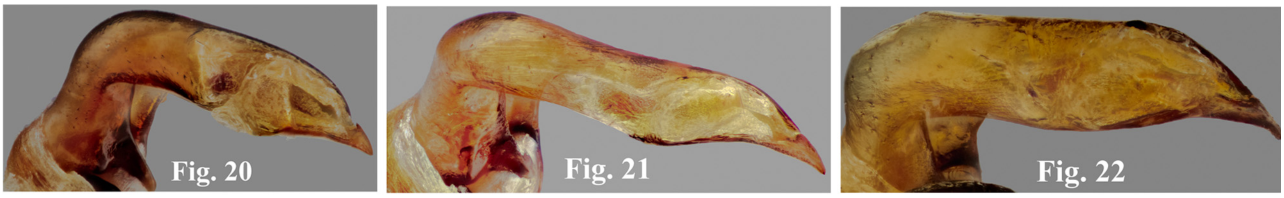
FIGURES 9–13. Last abdominal ventrite of species of *Pterostichus* (*Anilloferonia*). Figure 9, lateral view, male *P. malkini*. Figure 10, ventral view, male *P. malkini*. Figure 11, female *P. malkini*. Figure 12, male *P. diana*. Figure 13, male *P. testacea*.

The shape of the median lobe of the aedeagus of *P. malkini* differs from those of *P. diana* and *P. testacea* as follows: the median lobe is shorter and less sinuate in lateral view (Figures 14–19) and dorsal view (Figures 20–22), the right ventrolateral tumidity is much smaller and is very close to the base of the median lobe (versus large and more medially located) (Figures 17–19), the meeting of the shaft of the median lobe and the base is narrowly perpendicular in right lateral perspective (Figure 17) versus being arcuate and broader (Figures 18–19), the apex is shorter in both lateral and dorsal perspectives (Figures 14–22) and in dorsal perspective, the apex is less twisted to the anatomical left and the tip of the apex is more rounded (Figures 23–25).

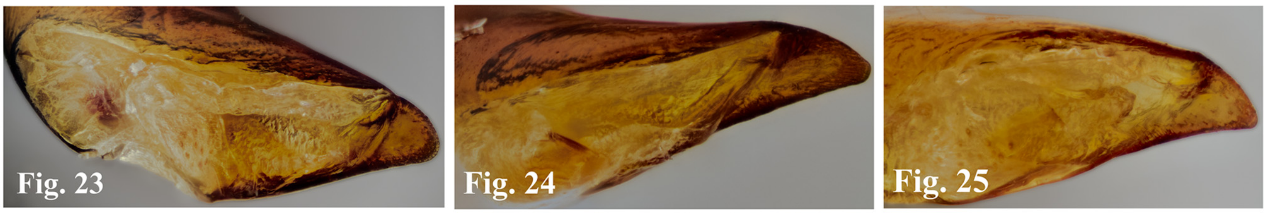


FIGURES 14–16. Left lateral views of median lobe of aedeagus of species of *Pterostichus* (*Anilloferonia*). Figure 14, *P. malkini*. Figure 15, *P. diana*. Figure 16, *P. testacea*.

FIGURES 17–19. Right lateral views of median lobe of aedeagus of species of *Pterostichus* (*Anilloferonia*). Figure 17, *P. malkini*. Figure 18, *P. diana*. Figure 19, *P. testacea*.



FIGURES 20–22. Dorsal views of median lobe of aedeagus of species of *Pterostichus* (*Anilloferonia*). Figure 20, *P. malkini*. Figure 21, *P. diana*. Figure 22, *P. testacea*.



FIGURES 23-25. Dorsal views of apex of median lobe of aedeagus of species of *Pterostichus* (*Anilloferonia*). Figure 23, *P. malkini*. Figure 24, *P. diana*. Figure 25, *P. testacea*.

Collecting and habitat data for *Pterostichus malkini*

Collecting data for the type specimen are: Oregon, Coos County, Charleston, under a log, Borys Malkin, 10 July 1951 (Hatch 1953, p. 119). No more details are available. Collecting data for my specimens are: Oregon, Coos County, Charleston, Coos Head; elevation 45 m, 43.35087 º N, -124.33694 º W, J.R. LaBonte, 17 March 1985, two specimens hand collected under a fallen branch and one specimen later extracted from Douglas-fir litter from that locale, one female and two males; elevation 50 m, 43.34652º N, -124.33146º W, J.R. LaBonte, 24 March 2011, one specimen hand collected under a deeply imbedded large branch and one specimen later extracted from litter from that vicinity, one female and one male. My two collecting sites were about 0.7 km apart.

Both of the contemporary collecting sites were forested. The dominant tree species at the 1985 site was western hemlock (*Tsuga heterophylla* (Rafinesque) Sargent), with some Douglas-fir (*Pseudotsuga menziesii* (Mirbel) Franco) and western red cedar (*Thuja plicata* Donn) intermixed. The canopy was more-or-less closed and the shrub understory was dense. The hand collected *P. malkini* were found amidst a dirt bulldozed road about 15 m from the forest edge. At the 2011 site, the forest was composed of approximately equal proportions red cedar and western hemlock, with some Sitka spruce (*Picea sitchensis* (Bongard) Carruthers as well. The stand was predominantly closed-canopy and the shrub understory was dense in patches. The specimen that was hand collected was found within the stand, as was the litter from which the second specimen was subsequently extracted. Neither site consisted of undisturbed or old growth forest, having been logged. The trees at the 1985 site were all relatively young, probably less than fifty years old. There were a few older trees at the 2011 site but most were young or mature.

Discussion

Discovery of additional specimens, especially males, of *P. malkini* was the key to my recognizing the validity of this species. I made several efforts, in vain, to acquire a large series of this species and to find localities outside of the vicinity of what is apparently the type locality (see Hatch 1953, p. 119: Oregon, Coos County, Charleston). Although I would hesitate to regard any species of *P.* (*Anilloferonia*) as "easily collected", for whatever reasons *P. malkini* appears unusually elusive. Even Hilary Hacker, one of the most successful collectors of specimens of *P.* (*Anilloferonia*) and who collected extensively throughout the southern Oregon Coast for her revision of *P.* (*Leptoferonia*) (Hacker 1968), failed to collect *P. malkini*.

Despite being known from only six specimens and with essentially only one known locality since *P. malkini*'s description sixty years ago, it is premature to consider this species as threatened or endangered. Endogean beetles, those living all or the bulk of their lives within the soil, can be inherently challenging to collect. This is undoubtedly one of the reasons known ranges of many endogean species are extremely small, such as for many Anillina (Carabidae: Trechinae: Bembidiini) (e.g., Sokolov et al. 2004). For instance, endogean carabids in the Pacific Northwest are most readily found when the soil column is moist up to the surface, that is, in winter and early spring. This is also the period when the weather is at its most inclement and when most entomologists and collectors are least active in the field. Furthermore, only the periphery of the habitat (the upper few centimeters of the soil) of such carabids is accessible via hand collecting, which is the strategy enabling the greatest coverage of potential habitat. Insects active during seasons of low collecting activity and for which there are no truly effective and efficient collecting methods are normally poor candidates for formal threatened and endangered species protection.

Fortunately, the known localities for *P. malkini* are currently protected from development, which, as with most insects, is the greatest threat for extirpation. However, even if the forest stands where I've found *P. malkini* were totally destroyed by fire, wind throw or logging, I believe this species would persist as long as the forest was allowed to recover, largely because the true habitat, the soil, is buffered from such disturbances (e.g., Geiger 1971, Wallwork 1976). Along with the aforementioned high geographic localization, endogean beetles often also exhibit low vagility (Aalbu and Andrews 1985, Crowson 1981), in part because of habitat resistance to movement (Wolfenbarger 1975) and flightlessness. Because of these characteristics, the populations of *P. malkini* at known sites are almost certainly descended from progenitors which weathered both natural and anthropogenic stand replacing disturbances. The species has clearly survived previous natural stand replacement events which have been part of the forest history of coastal Oregon for as long as forests have existed there. Coastal spruce forests typical of the *P. malkini* sites experience stand replacing wind events about every 200-400 years and major forest fires about every thousand years (Agee 1996).

Logging by itself is not a fatal event for *P. malkini* populations. Both of the two known contemporary sites were completely logged in the past. Microphthalmous pterostichines, at least those in western Oregon, appear to tolerate logging (LaBonte, unpublished data). Of the approximately two dozen known sites for *P. diana*, only one is comprised of virgin forest and only two others are old growth stands. All remaining sites have at most mature forest and several stands are forty-five years or less in age. Stand replacement occurred at only one site due to fire: logging was the cause at all other sites. None of the eight or so known sites for *P. testacea* are old growth forest, although the stand replacing events at most of those sites were not anthropogenic but natural, i.e., volcanic eruptions (Harris 1980) and forest fires caused by lightning. Of the four known sites for *P.* (*Leptoferonia*) *rothi*, none are virgin forest, two are old growth stands, and one was approximately forty-five years old prior to recent logging. Logging was responsible for stand replacement at three sites, fire at only one.

Just over fifty years ago, in an analysis of the "blind" beetles of the Pacific Northwest, M.H. Hatch remarked "there is every reason to suspect that additional species of *Anilloferonia* exist in the region" (Hatch 1958, p. 209). Although that prediction has not yet come to pass, his treatment of the species of *Anilloferonia sensu stricto* has stood the test of time. The limited distribution of *P. malkini*, as well as that of *P. testacea* (LaBonte, unpublished data), along with the cryptic nature of *Anilloferonia*, offers hope that the expectations of the Dean of Pacific Northwestern Coleopterists will be met.

The five specimens of *P. malkini* other than the holotype are in my personal collection.

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