DESCRIPTION OF *PROFORMICA BOROWIECI* N. SP. (HYMENOPTERA: FORMICIDAE), A NEW SPECIES OF THE GENUS *PROFORMICA* RUZSKY, 1902 FROM GREECE

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Abstract.— The revision of the populations of ants of the genus *Proformica* in Greece recently led to the discovery of two new endemic species: *Proformica chelmosensis* Lebas & Galkowski, 2019, and *Proformica lebasi* Borowiec & Salata, 2022. With these descriptions, the number of *Proformica* species in Greece increased to four. The description of a new species, *Proformica borowieci* **n. sp.**, found on Mount Parnassus in Central Greece is presented in this article. Its characters make it a sister species to *P. chelmosensis* from the northern Peloponnese. Its name honours the immense work of Lech Borowiec in studies on the myrmecofauna of Greece. The morphological characteristics and those related to cuticular hydrocarbons of this new species are examined.

Key words.— *Proformica*, Greece, Borowiec

Introduction

There are currently 31 described species of *Proformica*. Most species have a distribution range limited to Central Asia dominated by large steppe-like areas that are favourable to the ecological needs of these ants. In Western Europe, the fragmentation of this type of habitat seems to have contributed to the isolation of populations that are now more or less engaged in speciation (see Galkowski *et al.* (2022) comments on the species inhabiting north of the Iberian Peninsula). Thus, in Greece, the *Proformica* species are present in rather small territories (Fig. 1). Limited access to material collected from this region

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additionally complicates studies on Greek *Proformica* and leads to erroneous records of some taxa. For example, the conception of the species *Proformica nasuta* (Nylander, 1856) *sensu* Galkowski *et al.*, 2017, leads to the rejection of the presence of this species in Greece (Lapeva-Gjonova *et al.* 2010, Borowiec 2014, Lebas & Galkowski 2019b).

In this work, we describe a new species: *Proformica borowieci* n. sp. found on Mount Parnassus in Central Greece. Its morphological characters make it a sister species to *P. chelmosensis* known from the northern Peloponnese.

Material and methods

Mount Parnassus (2,457 m) lies to the north of the ancient city of Delphi. In Greek mythology, Mount Parnassus is the home of the god Apollo and the nine muses, daughters of Zeus. It takes its name from Parnassos, son of the god Poseidon. Its slopes are home to Cephalonian firs, spruces and junipers, dotted with yellow-flowered bushes. The forest climbs to an altitude of around 1,800 metres. Beyond that, a subalpine meadow on the northern slopes owes its origin to the combined action of man (bauxite mines) and climate. The dry parts of these meadows are home to the Apollo butterfly, whose scientific name is *Parnassius apollo* (Fig. 2).

A population of ants of the genus *Proformica* discovered in May 2017 was the subject of more extensive sampling on 08 June 2021 to collect males and queens. The locations of the *Proformica* nests were plotted using a Garmin 20 GPS. Samples were placed in 75% ethanol for morphology and some workers were kept dry for hydrocarbon analysis. The distribution ranged from 1,993 m (N38 32.795 E22 35.508) on a path parallel to the ski resort access road to 2,231 m (N38 32.366 E22 35.990) at the top of the slopes. During the hottest hours, the workers were numerous, hunting for prey and gathering honeydew. The entrance to the nests is through small holes that can be seen in the materials removed from the galleries (Fig. 3).

Chemical analysis

For diagnosis of Greek *Proformica*, we compared *P. borowieci* n. sp. with three other species known from this country: *P. lebasi, P. oculatissima* and *P. chelmosensis*. All investigated samples were collected by Claude Lebas in May 2017 and June 2021.

Figure 1. Distribution of the genus *Proformica* in Greece.

Figure 2. Mount Parnassus, red arrow indicates the nesting site of *Proformica borowieci* n. sp.

Two or three workers from each of the studied colonies were collected and killed by freezing. All the ants were kept dry until chemical analyses. They were immersed in 1 ml of hexane for 60 minutes, after which the ants were retrieved from the vials and the solvent evaporated. Chemical analyses were performed via a GC/MS-TQ Agilent (GC 7890B, MS 7000C, Agilent Technologies, Santa Clara, CA, USA). The samples were re-dissolved in 50 ìl of hexane. Two μL of each extract were injected with an autosampler (Gerstel,

Figure 3. Entrance to a *Proformica* nest.

Mühleim an der Ruhr, Germany) into an injector heated at 280°C in splitless mode and then in a column compound of 5% Phenyl – 95% Dimethylpolysiloxane (Zebron ZH-5HT inferno, 30 m × 0.25 mm × 0.25 μm, Phenomenex, Torrance, CA, USA). The gas vector was helium at 1.2 ml min-1. The temperature program was 2 min at 150°C, and then increasing at 5°C/min to 320°C, and 5 min hold at 320°C (total 41 min). The transfer line was set at 320°C. We used an Electron Ionization source at 230°C with electron energy of -70 eV and a scan range of 40–600 m/z with 3.7 scans/s. Compounds were identified by their fragmentation pattern, compared to standard alkanes, library data, and Kovats retention indices. We did not analyze hydrocarbons under C20 which are partially volatiles and not important in species recognition. All hydrocarbon compounds after C20 were included in the analyses. When it was not possible to estimate the amount of each coeluted compound, they were treated as a single compound. Sterols and other contaminants like phthalates were not included.

All the percentages of HCs are provided as mean ± SE (Standard Error) in Table 1. The data were analyzed using cluster analysis on percentages with Euclidean distances and Ward method (Statistica 8.0 program). We also calculated the equivalent chain length which indicates the mean of hydrocarbons length ECL = (Ó(%CnxXn))/100) where Cn is the number of carbons and Xn the % of this category. ECL is not sufficient to discriminate species but is a good indication to classify them in different groups according to the length of hydrocarbons.

Cuticular hydrocarbon profiles (CHs) are a good indicator of species discrimination in insects. In ants, Martin and Drijfhout (2009) found more than 1000 hydrocarbons in 78 ant species, and each species possessed its unique pattern. In 12 species of European *Myrmica*, Guillem *et al*. (2016) found remarkable species-specific chemical profiles. On two *Temnothorax* and two *Myrmica* species, Sprenger and Menzel (2020) assigned the right species based on HCs with 0% errors.

Morphological analysis

Biometric measurements were taken using a micrometre mounted on a binocular magnifying glass, enabling observations at magnifications of ×40 to ×100. For each trait, values are provided as: min–max (average). Length measurements are expressed in mm:

HW – maximum head width (at eye level, eyes included in the measurement);
HL – maximum length of head (from vertex to anterior margin of clypeus);
SL – length of scape (average length of the two scapes);
nSc – number of erect setae on the scape (average number of the two scapes);
nCH – number of erect setae on vertex (head seen in frontal view);
nCU – number of erect setae under the head;
nPn – number of erect setae on the pronotum;
nMes – number of erect setae on mesonotum;
nPP – number of erect setae on the propodeum;
nEc – number of erect setae on the petiole;
nG – number of erect setae on the first segment of the gaster (excluding the row of hairs on the distar edge of the segment);
GHL – length of the longest erect setae on the first segment of the gaster;
PDG – pubescence density index on the gaster. The index corresponds to the ratio L/N where N is the number of short appressed hairs (pubescence) growing along a transverse line of length L (expressed here in μm);
EYE – maximum diameter of the compound eye (average of the two eyes);
MW – width of mesosoma measured at the tegulae.

The type material is stored in the Museum of Natural History, University of Wrocław, Poland (MNHW). All photos were taken by Claude Lebas.

Results

Hydrocarbons of the different species

The hydrocarbon profiles were clearly different and typical of each species (Fig. 4a, 4b, Table 1). There were mainly linear alkanes, di-, and trimethyl alkanes. We found very few alkenes (2%, except for *P. oculatissima* with 7.8%). Alcohols and other substances were also rare at these extraction temperatures. ECL are in two groups: a first one, around 30: *P. lebasi* (30.32), *P. chelmosensis* (29.8) and a second group around 26–27: *P. oculatissima* (26.90*), P. borowieci* (26.17). Higher ECL indicates that the cuticles have more heavy hydrocarbons and that it is a better adaptation to more dry and hot climates (see for example Menzel *et al*. 2018). Figure 4b presents the dendrogram of hydrocarbons with Euclidian distances. Two groups appear also clearly separating the 4 species. As the number of samples is small, it is difficult to obtain significant statistics; but generally, in the analyses a distance superior to 50 indicates different species. We only compared Euclidian distances between *P. borowieci* and *P. chelmosensis* (mean 32.4 ± 0.54) with intraspecies differences (mean 10.8 ± 1.11) and the difference is highly significant (Wilcoxon test $p = 0.003$, $n = 31$). It confirms the strong evidence for the validity of the new species.

Table 1. Concentration of hydrocarbons in % for the four species of Greek *Proformica*.

	Compound	*lebasi*		*borowieci* n. sp.		*chelmosensis*		*oculatissima*		mean
		moy	SE	moy	SE	moy	SE	moy	SE	for the X
Number	n=	2		5		4		2		4 species
1	C23	0.00	0.00	4.21	0.28	0.00	0.00	0.00	0.00	1.05
2	9+11C23	0.00	0.00	2.50	0.31	0.00	0.00	0.00	0.00	0.63
3	7C23	0.00	0.00	1.60	0.13	0.00	0.00	0.00	0.00	0.40
4	5C23	0.00	0.00	0.48	0.11	0.01	0.01	1.19	0.72	0.42
5	3C23	0.00	0.00	0.79	0.05	0.00	0.00	0.00	0.00	0.20
5b	9,11C23	0.00	0.00	0.80	0.08	0.00	0.00	0.05	0.02	0.21
5c	7,11C23	0.00	0.00	0.56	0.09	0.23	0.11	0.06	0.01	0.21
6	5,11+5,13+7,11+9,11C23	0.00	0.00	0.00	0.00	0.01	0.01	0.08	0.02	0.02
7	C24:1	0.00	0.00	0.00	0.00	0.15	0.07	0.04	0.02	0.05
8	C24	0.00	0.00	1.26	0.06	0.00	0.00	0.00	0.00	0.31
10	8+9+10+11+12C24	0.00	0.00	0.13	0.13	0.20	0.13	0.21	0.01	0.13
10b	7C24	0.00	0.00	1.69	0.17	0.00	0.00	0.00	0.00	0.42
11	6C24	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.02	0.02
13	8,12C24	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.05
14	C25:1	0.00	0.00	1.71	0.27	0.24	0.12	0.00	0.00	0.49
15	6,8+6,10C24	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.38	0.18
15b	4,10C24	0.00	0.00	0.42	0.17	0.00	0.00	0.00	0.00	0.10
16	C25	0.45	0.09	4.73	0.64	0.52	0.26	1.61	1.06	1.83
16b	4,8,12TM C24	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.04	0.06
17	9+11+13C25	0.45	0.19	2.84	0.53	0.26	0.12	1.78	0.02	1.33
18	7C25	0.07	0.03	6.60	0.40	0.00	0.00	1.09	0.11	1.94
19	5C25	0.06	0.05	1.24	0.51	0.00	0.00	0.54	0.07	0.46
20	9,13+9,15C25	0.00	0.00	4.13	1.04	0.00	0.00	3.01	0.11	1.78
21	3C25	0.38	0.21	0.00	0.00	0.63	0.40	5.83	0.06	1.71
22	7,15+7,17C25	0.00	0.00	8.99	0.72	0.00	0.00	0.00	0.00	2.25
23	5,9+5,13+5,15C25	0.09	0.04	1.38	0.33	0.00	0.00	2.15	0.09	0.91
25	C26	0.19	0.08	0.82	0.11	0.16	0.08	1.22	0.09	0.60
27	8+9+10+11C26	0.29	0.12	1.45	0.11	0.29	0.12	3.26	0.13	1.32
27b	11,13,15+13,15,17TriMeC25	0.25	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.06
27c	7,11,15C25	0.00	0.00	2.14	0.25	0.00	0.00	3.23	0.14	1.34
28	8,12 DiMe C26	0.00	0.00	1.85	0.43	0.00	0.00	1.71	0.10	0.89
28b	7C26	0.00	0.00	1.79	0.18	0.00	0.00	0.00	0.00	0.45
29	6C26	0.02	0.01	0.00	0.00	0.14	0.07	0.00	0.00	0.04
30	5C26	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03
31	2+4 Me C26	0.63	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.16
33	C27:1	0.00	0.00	0.00	0.00	0.18	0.12	4.96	0.06	1.28
34	6,8+6,10C26	0.31	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.08
35	4,8+4,10C26	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.05

Table 1. Continued.

	Compound	*lebasi*		*borowieci* n. sp.		*chelmosensis*		*oculatissima*		mean
		moy	SE	moy	SE	moy	SE	moy	SE	for the X
Number	n=	2		5		4		2		4 species
35b	2,10C26	0.00	0.00	1.17	0.72	0.00	0.00	0.00	0.00	0.29
36	C27	1.68	0.36	1.74	0.11	2.14	0.54	3.35	0.05	2.23
36b	4,8,12 TriMeC26	0.00	0.00	0.00	0.00	0.00	0.00	3.04	0.12	0.76
37	9+11+13 Me C27	1.62	0.66	3.12	0.98	0.68	0.05	5.25	0.17	2.67
38	7C27	0.14	0.06	3.67	0.80	0.10	0.06	1.45	0.05	1.34
39	5 Me C27	0.28	0.12	0.47	0.25	0.35	0.15	1.13	0.01	0.56
40	11,13C27	0.50	0.22	1.24	0.30	0.00	0.00	0.00	0.00	0.43
40b	9,13C27	0.00	0.00	9.02	2.39	0.00	0.00	0.89	0.02	2.48
41	3 Me C27	1.32	0.40	0.00	0.00	0.04	0.001	13.39	0.27	3.69
41b	7,11C27	0.00	0.00	0.59	0.24	0.52	0.17	0.00	0.00	0.28
42	5,9+5,15+5,17C27	0.38	0.17	0.00	0.00	1.65	0.48	7.44	0.20	2.37
43	3,9C27	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.03	0.15
44	C28	1.36	0.40	0.24	0.15	1.39	0.31	7.06	0.23	2.51
46	3,7+3,9C27 + 3,10+3,12C27 ??	0.47	0.19	4.96	0.98	0.26	0.12	0.00	0.00	1.42
46b	7,11C28	0.00	0.00	3.76	0.43	0.00	0.00	0.00	0.00	0.94
47	8+9+10+12+14 Me C28	0.05	0.04	1.19	0.47	0.00	0.00	10.43	0.32	2.92
50	7 Me C28	0.00	0.00	0.48	0.11	0.00	0.00	0.00	0.00	0.12
51	6 Me C28	0.00	0.00	0.00	0.00	0.05	0.03	0.00	0.00	0.01
51b	C29:2	0.00	0.00	0.26	0.04	0.00	0.00	0.00	0.00	0.07
52	4 Me C28	3.39	1.43	0.00	0.00	0.18	0.10	1.03	0.04	1.15
54	10,12+10,14 DiMeC28	0.00	0.00	1.61	0.34	0.00	0.00	0.00	0.00	0.40
57	6,10+6,12+6,14 DiMe C28	0.00	0.00	0.00	0.00	0.65	0.23	0.00	0.00	0.16
58	C29:1	0.67	0.27	0.21	0.13	0.00	0.00	2.78	0.16	0.92
59	4,8+4,10+4,12 DiMe C28	1.85	0.75	0.17	0.07	0.44	0.10	2.03	0.08	1.12
60	C29	2.68	5.89	1.41	0.20	15.57	2.27	0.66	0.05	5.08
60b	6,10,14TriMe C28	0.44	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.11
61	4,8,11+4,8,14+4,10,14C28	0.00	0.00	0.00	0.00	0.00	0.00	1.70	0.07	0.42
62	9+11+13+15 Me C29	4.23	1.40	0.38	0.23	9.18	1.16	0.24	0.01	3.51
63	7 Me C29	0.33	0.14	1.19	0.30	0.56	0.21	0.00	0.00	0.52
64	5 Me C29	0.00	0.61	0.00	0.00	3.76	0.58	0.40	0.02	1.04
65	11,15+13,15 DiMe C29	2.05	1.45	0.65	0.17	0.23	0.23	0.00	0.00	0.73
66	9,13C29	1.91	1.35	2.18	0.44	1.51	0.32	0.00	0.00	1.40
67	3 Me C29	1.76	3.41	0.00	0.00	3.77	0.28	1.43	0.06	1.74
68	7,11+7,15+7,17 DiMe C29	1.28	0.55	0.28	0.28	0.79	0.46	0.00	0.00	0.59
69	5,9+5,15+5,17 Di Me C29	0.73	0.26	0.79	0.15	9.47	2.17	1.18	0.05	3.04
70	C30	0.00	0.00	0.00	0.00	0.78	0.09	0.00	0.00	0.20
71	3,9+3,11C29	0.00	0.00	0.00	0.00	2.91	0.55	0.43	0.02	0.84
73	7,11,13+7,11,15C29	1.00	0.48	2.58	0.07	0.14	0.09	0.00	0.00	0.93
74	5,11,13+3,7,11C29	0.80	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.20

Table 1. Continued.

	Compound	*lebasi*		*borowieci* n. sp.		*chelmosensis*		*oculatissima*		mean
		moy	SE	moy	SE	moy	SE	moy	SE	for the X
Number	n=	2		5		4		2		4 species
75	8+9+10+11+12 Me C30	2.05	1.19	0.16	0.04	1.87	0.35	0.49	0.02	1.14
77b	6C30	0.00	1.36	0.00	0.00	0.28	0.06	0.00	0.00	0.07
78	8,12+8,14 DiMe C30	1.81	1.86	0.00	0.00	0.00	0.00	0.00	0.00	0.45
79	4 Me C30	4.05	1.69	0.00	0.00	0.84	0.16	0.03	0.00	1.23
81	6,10+6,12+6,14C30	0.33	0.15	0.09	0.03	1.23	0.07	0.05	0.01	0.43
83	C31:1	0.31	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.08
84	4,8+4,10+4,12+4,14+4,16 DiMe C30	5.87	2.47	0.00	0.00	0.67	0.19	0.004	0.00	1.65
85	C31	0.24	3.63	0.56	0.12	2.54	0.56	0.03	0.00	0.84
87	6,14,16+6,10,12+6,12,16C30	2.67	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.67
88	4,10,12+4,12,16+4,14,16 TriMe C30	0.00	2.63	0.00	0.00	0.06	0.06	0.02	0.00	0.02
89	9+11+13+15+16 Me C31	9.28	3.83	0.08	0.05	4.30	2.06	0.03	0.00	3.42
90	7C31	0.00	0.00	0.00	0.00	0.48	0.22	0.00	0.00	0.12
93	9,11+9,13+9,15 DiMe C31	12.01	5.06	0.36	0.12	0.00	0.00	0.00	0.00	3.09
94	5C31	0.00	0.00	0.00	0.00	1.27	0.47	0.00	0.00	0.32
95	7,11+7,15C31	0.81	0.37	0.16	0.05	5.15	3.42	0.00	0.00	1.53
95b	3C31	0.35	2.41	0.00	0.00	1.66	0.20	0.00	0.00	0.50
96	5,9+5,13+5,15+5,17 DiMe C31	1.18	0.49	0.13	0.08	3.09	0.81	0.14	0.11	1.14
96b	11,15,19+13,15,19C31	0.00	0.00	0.00	0.00	2.63	0.93	0.00	0.00	0.66
98	7,11,17+7,13,17C31	0.00	0.00	0.00	0.00	0.48	0.29	0.00	0.00	0.12
99	C32	0.00	0.00	0.00	0.00	1.12	0.40	0.04	0.03	0.29
100	3,11C31	2.15	0.88	0.19	0.09	0.00	0.00	0.00	0.00	0.58
102	8 +10 +11+12+13+14Me C32	3.82	1.56	0.00	0.00	0.63	0.18	0.00	0.00	1.11
103b	12,14+12,16C32	3.03	1.24	0.79	0.30	0.00	0.00	0.00	0.00	0.95
104	8,14 + 8,16 +10,12+10,14DiMe C32	0.00	0.00	0.00	0.00	0.11	0.10	0.00	0.00	0.03
106	6,10+6,14DiMe C32	0.60	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.15
109	C33	0.00	0.00	0.00	0.00	0.39	0.27	0.00	0.00	0.10
111	11+13+15+17 Me C33	1.75	11.26	0.00	0.00	4.25	1.82	0.00	0.00	1.50
112	13,15 C33	1.84	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.46
113	11,13+11,15C33	2.79	1.14	0.00	0.00	0.00	0.00	0.00	0.00	0.70
113b	9,11+9,17+(9,15+9,19) C33	5.70	2.40	0.00	0.00	0.00	0.00	0.00	0.00	1.42
115	7,11+7,15C33	0.00	0.00	0.00	0.00	0.12	0.08	0.00	0.00	0.03
115b	5,11+5,13+5,15C33	0.80	0.34	0.00	0.00	3.80	1.15	0.00	0.00	1.15
116	5,11,15+5,13,15C33	1.18	0.53	0.00	0.00	1.11	1.11	0.00	0.00	0.57
120	10+12C34	1.25	0.51	0.00	0.00	1.62	1.58	0.00	0.00	0.72
122	8,12,16+8,12,18+8,14,16+8,14,16C34	0.00	0.00	0.00	0.00	0.14	0.14	0.00	0.00	0.04
	TOTAL	100.0		100.0		100.0		100.0		100.0
										nb HCs
	ECL (Equivalent Chain Length)	30.32	0.20	26.17	0.006	29.80	0.10	26.90	5.48	112

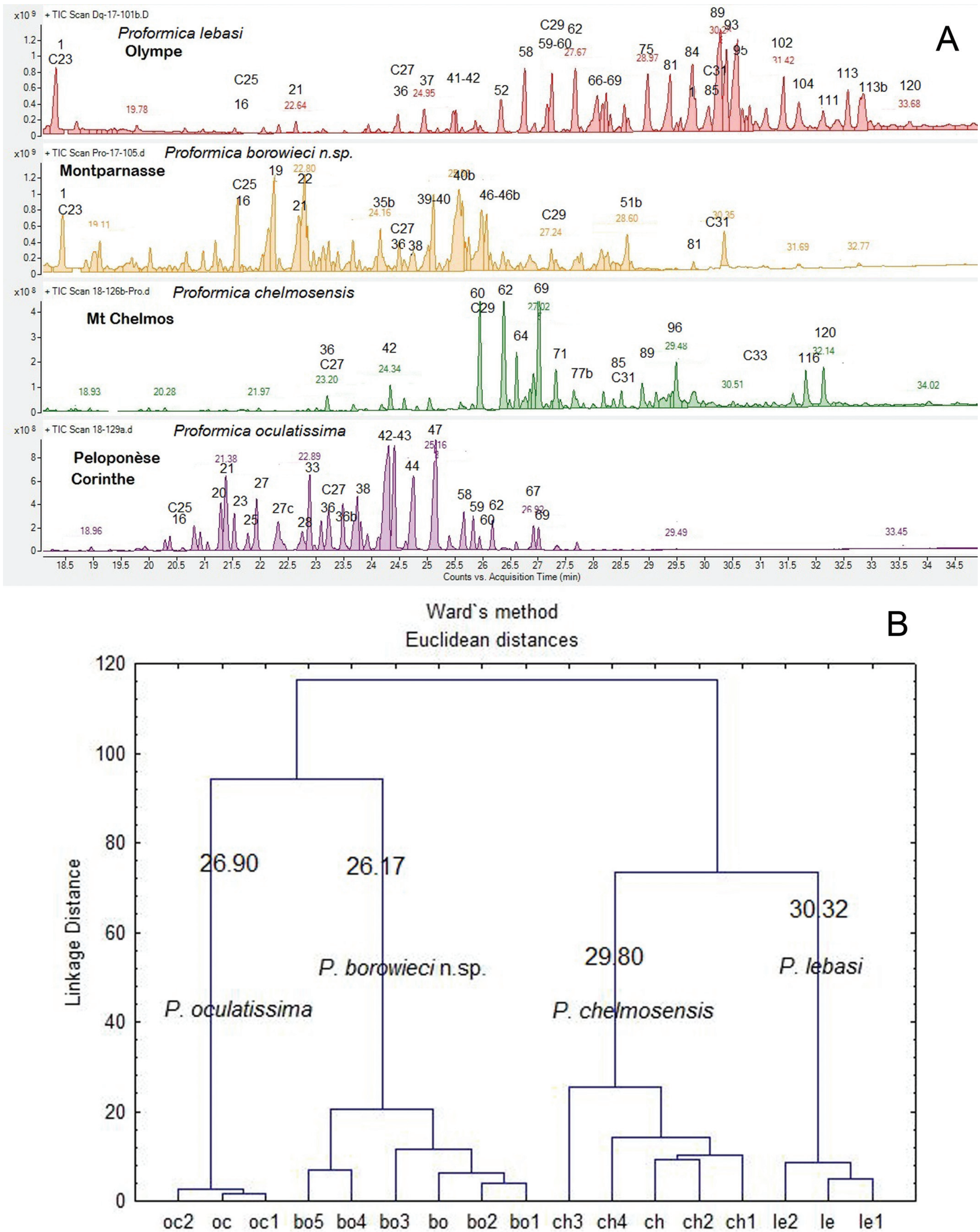


Figure 4. (A) Hydrocarbons profiles of the four Greek *Proformica* species. Numbers correspond to those used in Galkowski *et al*. 2017. New ones are indicated with b. The retention times are different according to the species as they have been made with different columns; (B) Dendrograms of Euclidian distances for the four species. ECL are indicated on the figure.

Proformica borowieci n. sp.
(Figs 5–10)

Type material. Holotype: major worker (pin): Mount Parnassus, N38 32.795 E22 35.508, 1993 m a.s.l., 08 June 2021 (MNHW). Paratypes: 3 workers, 1 male: the same locality as holotype (MNHW).

Etymology. The species name is given in honnour of Lech Borowiec author of numerous publications on the myrmecofauna of Greece.

Description. Workers. Minor workers (n = 10): HW 0,66–0,86 (0,73); HL 0,75–1,05 (0,91); SL 0,75–0,93 (0,85); nSc 0–1 (0,03): nCH 0–1 (0,09); nCU 0–2 (1,20); nPn 4–7 (5,20); nMes 2–7 (4,11); nPP 1–3 (2,21); nEc 1–3 (2,00); nG 5–13 (8,58); GHL 0,09–0,17 (0,13); PDG 52–68 (56); HW/HL 0,80–0,85 (0,82); SL/HW 1,07–1,19 (1,11); SL/HL 0,83–0,96 (0,88). Major workers (n = 15): HW 0,99–1,38 (1,15); HL 1,19–1,50 (1,29); SL 0,97–1,20 (1,05); nSc 0–2 (0,14); nCH 0–2 (0,85); nCU 1–4 (2,50); nPn 6–11 (8,85); nMes 8–14 (10,14); nPP 4–9 (7,11); nEc 2–4 (3,14); nG 10–30 (19,42); GHL 0,08–0,17 (0,13); PDG 34–68 (53); HW/HL 0,73–0,92 (0,89); SL/HW 0,85–0,99 (0,92); SL/HL 0,72–0,88 (0,82)

Head, mesosoma, petiolar scale and gaster dark brown to black, antennae yellowish with apical 3–4 antennomeres slightly infuscate, coxa brown, femora dark brown with yellowish apex, tibiae and tarsi yellowish brown. Head longer than wide, especially in minor workers, mandibles broad with longitudinal sculpture with large apical apical dent and four smaller denticles on masticatory margin. Clypeus on the whole surface with longitudinal striation. Head with micropunctation between punctures, frons with microstriation. Whole surface of head with sparse, short appressed pubescence and 0–2 erect setae in occipital margin, and 0–4 setae on ventral side. Scape distinctly reaching beyond the occipital margin of head. Mesosoma elongate, in dorsal view distinctly constricted in the middle. Whole mesosoma with rather dense appressed pubescence, mesonotum at top micropunctate with smooth and shiny interspaces, on sides microreticulate and slightly dull, propodeum microreticulate and slightly dull. Pronotum with 4–11, mesonotum with 2–14 and propodeum with 1–9 long erect setea. Petiolar scale thick in lateral view, apical margin emarginate in major workers with 1–4 erect setae. Surface of gaster shiny covered with sparse appressed pubescence. First gastral tergite with 5–30 long erect setae. Legs covered with dense pubescence, femora and tibiae with few erect setae.

Description. Gyne (n = 2): HW 1,56; HL 1,53; SL 1,29; MW 1,02; nSc 0; nCH 0; nCU 8; nPn 10; nEc 1,5; nG 11; GHL 0,20; PDG 17; HW/HL 1,02; SL/HW 0,81; SL/HW 0,83.

Very dark, black body with dark brown mandibles and appendages. The head is barely wider than it is long. Sculpture of the tegument like that of the major worker, the clypeus is finely sculptured with longitudinal striations, the striations do not extend between frons, the tegument is only finely punctuated and appears quite shiny. The frontal furrow is clearly visible. Dense pubescence all over the head and on the antennal scapes. Mesosoma complete with wing scars. Pubescence dense with numerous erect setae Petiole in the form of a high scale with a very deeply indented apex. Gaster voluminous with very dense pubescence and erect setae. Tegument fairly shiny. Legs with dense pubescence and a few upright setae.

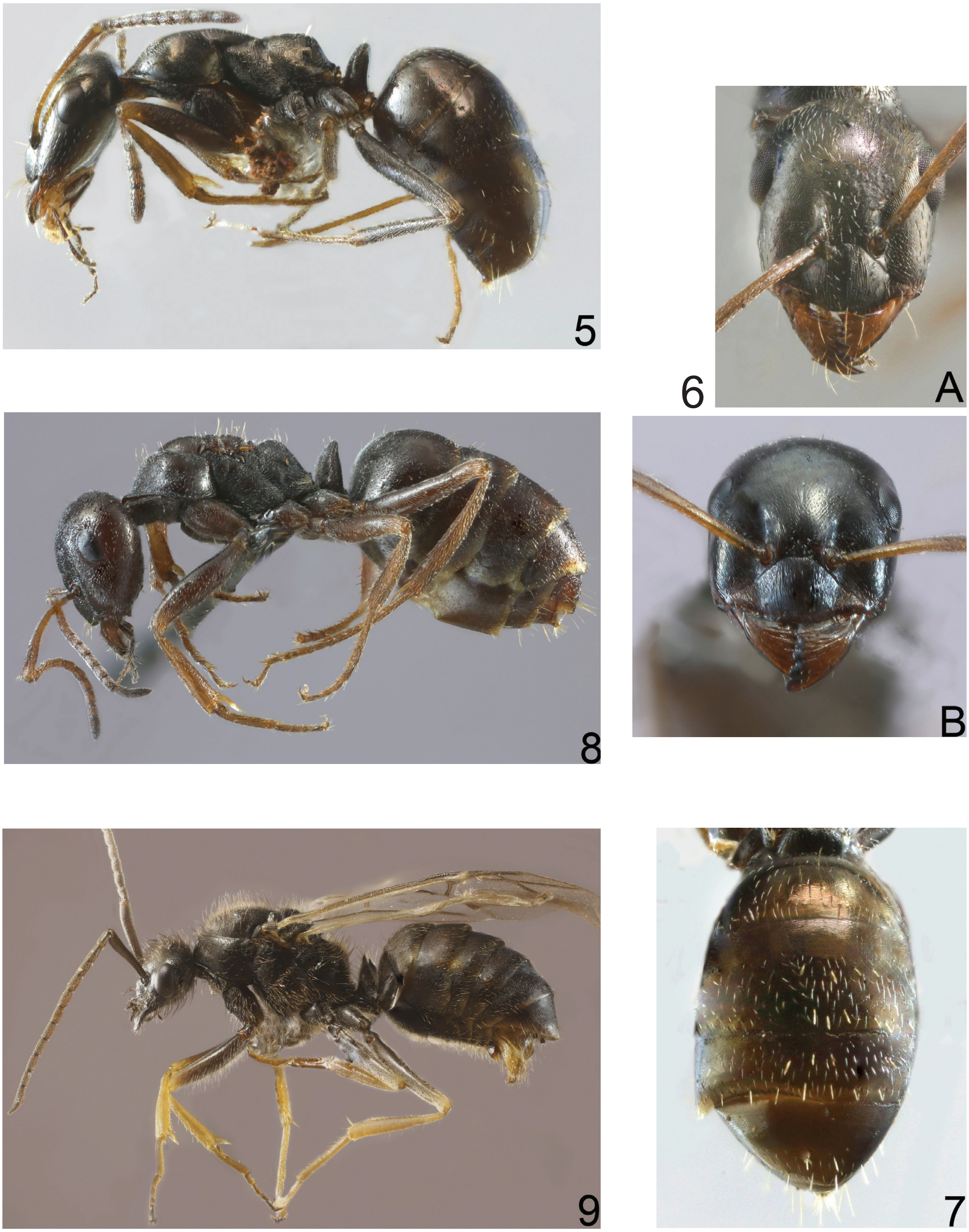
Description. Male (n = 10): HW 1,30–1,34 (1,32); HL 1,19–1,23 (1,21); SL 1,13–1,17 (1,15); EYE 0,49–0,52 (0,51); MW 1,53–1,63 (1,56); HW/HL 1,08–1,10 (1,09); SL/HL 0,93–0,98 (0,95); SL/HW 0,72–0,78 (0,74); HL/EYE 2,30–2,45 (2,39).

Whole body dark brown, only the appendages are slightly lighter, the funiculi and femurs less dark brown, and the tibiae and genitalia light brown to yellowish. The setae on this caste are much more abundant on the head and mesosoma. The entire head is covered in long, erect setae. There is no pubescence, however, and the tegument is clearly visible, uniformly sculpted with a fine reticulation giving it a matt appearance. The mandibles are slender and have a single apical tooth. Ocelli are clearly visible on the occipital part of the head. The eyes are large. The scapes do not have erect setae, but are covered with very fine, dense pubescence. The long erect setae cover the entire mesosoma, and there is a fine sculpture forming small striations on the integument. The petiole is in the form of a thick scale, less high than in workers and queens, with a clearly emarginate apex. The gaster is subshiny, the fine wrinkled sculpture is present but only slightly attenuated, the pilosity is much sparser, with long setae present only on the anterior surface of the first tergite and at the posterior end of the segments. Dense pubescence over the entire gaster. The genitalia is very conspicuous and occupy almost a third of the volume of the gaster.

Diagnosis. The morphological characters of *Proformica borowieci* n. sp. that separate it from the remaining Greek species are as follows:

Proformica oculatissima (Forel, 1886) possesses characteristic males with very large eyes (HL/EYE 1.35), reduced pilosity and yellowish gaster. Workers have less and shorter setae (GHL < 0.08). Their integument is less shiny due to more developed microsculpture. The queen caste is unknown. This species is found in lowland areas in Attica and the northern Peloponnese.

Proformica striaticeps (Forel, 1911) and *Proformica lebasi* Borowiec & Salata, 2022 are also characterised by workers with reduced or even absent pilosity and short erect setae (GHL < 0.08) if present. Their integument is less shiny due to more developed



Figures 5–9. *P. borowieci* n. sp. (5) Minor worker, lateral view; (6) head: A – Minor worker, B – Major worker; (7) Minor worker, gaster; (8) Gyne, lateral view; (9) Male, lateral view.

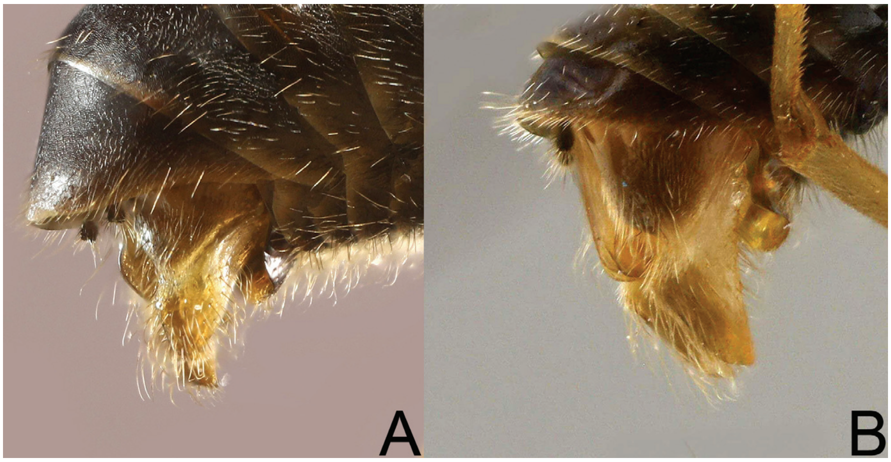


Figure 10. Male genitalia. (A) *Proformica borowieci* n. sp., lateral view; (B) *Proformica chelmosensis*, lateral view.

microsculpture. Males of these two species are unknown. The individual photographed on Antweb with the references CASENT0911063 potentially presents a queen of *Proformica striaticeps*, which would then be apterous. The queen of *Proformica lebasi* is unknown. These two species are found in northern Greece, in the plains of central Macedonia and on the southern flank of Mount Olympus.

Proformica chelmosensis Lebas & Galkowski, 2019 is the species that most closely resembles *Proformica borowieci*. In these two species, the workers have very dark bodies with pilosity characterised by large erect setae (GHL > 0.08), the males have eyes that are not very well developed (HL/EYE > 2) and the queens are winged. However, differences are visible in the three castes: in the workers, the integument is more sculpted (this is visible in particular on the head) in *P. chelmosensis* and the pilosity more abundant (in the major worker nCH 8–18; nCU 1–8; nPn 14–28; nMes 10–20; nPP 10–29; nG 14–32). The male of *P. chelmosensis* is slightly smaller (HW 1.29; MW 1.45) with proportionally slightly larger eyes (HL/EYE 2.18). The stipes of the male of *P. borowieci* are longer and less wide than those of *P. chelmosensis* (**fig** ??). The gyne of *P. chelmosensis* is a little smaller (HW 1,53) with much more abundant erect setea (nCH 6; nCU 4; nPn 12; nEc 20; nG 14). *Proformica chelmosensis* is currently only known from high altitude stations on Mount Chelmos in the north of the Peloponnese.

Comments. With the description of *P. borowieci*, the number of *Proformica* species in Greece now rises to five. Prospecting in the country is continuing and may yet bring new findings. The country's compartmentalised geography and environmental characteristics are propitious for the individualisation of potentially genetically isolated lineages. Populations have recently been identified in western Greece and on the island of Cephalonia. The evaluation of these populations will have to be based on knowledge of the three castes and possibly the support of molecular data to specify the relationships of kinship within this complex genus of ants.

The taxonomy of Greek *Proformica* is still fragmentary and establishing dichotomous keys for these species is still premature. The three castes are known for only two of the five species, and not all the populations that constitute these species have been studied. Thus, a key to their determination could only lead to possible misidentifications.

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