

New data on the distribution, biology and morphology of *Asemum tenuicorne* Kraatz, 1879 (Coleoptera: Cerambycidae), with new records from Poland

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We report the discovery of the pyrophilous species, *Asemum tenuicorne* (Coleoptera: Cerambycidae) in the Białowieża Primeval Forest (NE Poland) in 2009 and 2016. This species was previously known only from Southern Europe and one locality detached from the main range on the island of Gotska Sandön in Southern Sweden. Information on its northern spread and current distribution is summarized and critically analyzed and new data on its biology are provided. The morphology of *A. tenuicorne* adults was studied using 46 specimens from different localities and compared with 63 specimens of the widely distributed *Asemum striatum*. Differences between the two species are presented and illustrated using external features, morphometric measurements, shape of the male copulatory organs and wing venation.

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1. Introduction

The genus *Asemum* Eschscholtz, 1830 belongs to the tribe Asemini Thomson, 1860 in the subfamily Spondylidinae Audinet-Serville, 1832. This genus comprises nine species distributed in the Palaearctic region (*A. arisanum* Kano, 1930; *A. lucidulum* Pesarini & Sabbadini, 1997; *A. punctulatum* Blessig, 1872 and *A. tenuicorne* Kraatz, 1879), Nearctic (*A. australe* LeConte, 1850; *A. caseyi* Linsley, 1957; *A. glabrellum* Bates, 1892 and *A. nitidum* LeConte, 1873) and Holarctic (*A. striatum* (Linnaeus, 1758)) (Monné 2006, Löbl & Smetana 2010, Bezark 2016).

The distribution of longhorn beetles in Eu-

rope is relatively well known (Bense 1995, Sama 2002, Löbl & Smetana 2010, Danilevsky 2017). Two localities in Central and Northern Europe stand out in terms of species richness of saproxylic beetles, including Cerambycidae: Gotska Sandön (Sweden) and the Białowieża Primeval Forest (Poland / Belarus) (Gutowski & Jarošewicz 2001, Ehnström & Axelsson 2002). *Asemum tenuicorne* is generally found in southern Europe but has also been known for many years in an isolated population on the island of Gotska Sandön.

On April 28, 2009, a ground-level fire occurred over about 7 ha of a 140-year-old natural forest stand in Białowieża National Park, affect-



Fig. 1. Burned area in the Białowieża Primeval Forest where two specimens of *Asemum tenuicorne* were collected.

ing the following habitats: moist forest (60.5% of the affected area), swampy forest (24.5%), and mixed coniferous forest (13.2%). This and other researches were undertaken to compare changes in species diversity, abundance and composition of beetles (with particular reference to saproxylic species) as a result of disturbance caused by the fire in the pine-spruce forest ecosystem. Activities carried out in these study areas were limited to observations and scientific research.

Starting just a few days after the fire, beetles were collected from the fire-affected area (Fig. 1) and from a similar stratum of forest unaffected by the fire, using Moericke traps (Moericke 1951), barrier traps of the Netocia type (Piętka & Borowski 2015) and IBL-2 type traps (Borowski & Marczak 2015). The collections occurred in 2009–2011 and 2015–2018. In the course of these studies, we collected two specimens of *Asemum tenuicorne*, a new species record from Poland.

Here we present a critical analysis of information in the literature on *Asemum tenuicorne* – a little-known cerambycid species, as well as new data on its distribution, morphology and biology.

2. Materials and methods

To examine as large number of specimens of *A. tenuicorne* as possible and to compare morphological characters with the sympatric species, *A. striatum*, we searched the entomological collections of the most important institutions in Poland

(e.g. Institute of Systematics and Evolution of Animals, Pol. Acad. Sci., Kraków; Museum and Institute of Zoology, Pol. Acad. Sci., Warszawa; Museum of Natural History, Wrocław University, Wrocław) as well as private collections of the following entomologists: Paweł Górski (PG), Lech Karpiński (LK), Roman Królik (RK), Andrzej Lasoń (AL), Jerzy Ługowoj (JL), Tomasz Olbrycht (TO), Radosław Plewa (RP), Wojciech Szczepański (WS), Marcin Szewczyk (MS), Jan Tatur-Dytkowski (JT-D), including the authors, J. M. Gutowski (JMG) and J. Kurzawa (JK).

In addition to the specimens from the Białowieża Primeval Forest, the following *A. tenuicorne* specimens from Italy and Greece were examined (b: black form, br: brown form):

Italy: 1♂ (br) – Toscana: Firenze, Crespino di Marradi, leg. M. Benelli, ex larva: *Pinus*, sfarfallato it: V 05[05.2005], coll. RP; 2♀ (b, br) – Emilia-Romagna: Casola Valsenio, ex. *Pinus*, VI.2016, leg. Casadio, coll. LK; 1♀ (br), 2♂ (br) – Siena, Monte Amiata, 13.II.2004, leg. Benelli M., coll. JK; 1♂ (b) – Toscana, Firenze, Badia della Valle, 3.V.2010, leg. Benelli M., coll. JK; 5♀ (br), 8♂ (br), 7♂ (b) – Toscana, Firenze, Casaglia, ex *Pinus*, 1–15.V.2010, leg. Benelli M., coll. JK.

Greece: 1♀ (br), 1♀ (b) – Thessaly, Mount Ossa, 1,300 m a.s.l., 39°50'N, 22°42'E, 31.V.2016, leg. et coll. JK & WS; 3♀ (br), 2♀ (b), 1♂ (br), 3♂ (b)

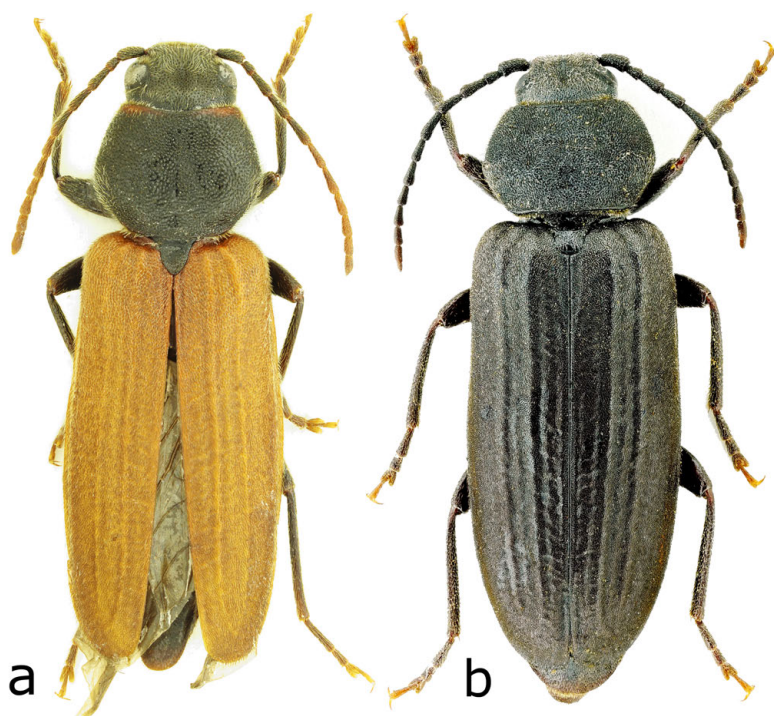


Fig. 2. Adult females.
– a. *Aseum tenuicorne* (Białowieża Forest). – b. *A. striatum* (Poland).

– Peloponnese, Taygetos mts., 1,086 m, 3 km SE Artemisia, 37°04'N, 22°14'E, 11.VI.2009, leg. MS, coll. JK, AL, JL & MS; 1♀ (b), 1♂ (br) – Peloponnese, Taygetos: Neochori, 27.V.2010, leg. Martinů, coll. RP; 1♀ (b), 1♂ (br) – Peloponnese: Neochori, Ag. Nikolaos, 1,300 m, 28.V.2015, leg. M. Egger, coll. AL & RK; 1♂ (br) – Peloponnese, [Taygetos mts.,] Ag. Vasileios – Artemisia, 13.VI.2009, leg. J. Kalisiak, coll. PG; 1♀ (b) – Ellada, [Peloponnese], around Ag. Petros, 19.V.2009, under burnt bark of *Pinus nigra* Arn., JT-D leg. et coll.; 1♂ (b) – Peloponnese, Paleopanagia, 14–15.VI.2006, leg. Martinů I., coll. JK.

All available specimens of *A. tenuicorne* (19♀, 27♂) and *A. striatum* (24♀, 39♂) were examined and the following measurements taken: 1) the length of the left and right elytra, 2) the width of the prothorax at its widest point, 3) the length of the prothorax, 4) the combined maximum width of the elytra and 5) the length of the body from the apex of the mandibles to the posterior margin of the tergite VII. The measurements were made using two methods: directly, using a Carl Zeiss Jena

CITOVAL-2 stereoscopic microscope with a special measuring eyepiece with an accuracy of 0.1 mm, and from photographs taken with a Wild Leica M8 microscope with a Nikon D7200 reflex camera using the TouPView program. Photographs of the wing venation for diagnostic purposes were made immediately after wet dissection of four specimens of each species.

Statistical calculations and charts were made using MS Office Excel 2013, R 3.5.0 and PAST 3.16 (Hammer *et al.* 2001). To compare differences between species and between sexes within species we used Generalized Linear Mixed Model (GLMM) with a Gaussian distribution for the response variable. Metric features of both species were correlated with each other and were difficult to analyze in one model. Therefore, the three most significant features were selected: body length, ratio of length and width of the prothorax, and ratio of length and width of the elytra. The distribution of body lengths did not deviate from normality, whereas values for both ratio features were log-transformed prior to analyses to achieve normality. The explanatory variables were species and sex, both as a two-level

Table 1. Differential features of European species of genus *Asemum*.

<i>Asemum tenuicorne</i>	<i>Asemum striatum</i>
Body slender: proportion of length to width of elytral base on average 3.3 (Table 2)	Body broader: proportion of length to width of elytral base on average 3.7 (Table 2)
Body flat in lateral view (especially elytra)	Body convex in lateral view (especially elytra)
Sculpture of elytra fine, not wrinkled; transverse longitudinal costae less distinct	Sculpture of elytra coarse, wrinkled, transverse; elytron with 2–4 longitudinal costae
Frons slightly depressed, without furrow	Frons deeply depressed, with distinct bordered furrow
Third, fourth and fifth segment of antennae distinctly longer than first segment of antennae (Figs 2a, 3a)	Third, fourth and fifth segment of antennae not longer than first segment of antennae (Figs 2b, 3b)
Third segment of antennae slender, 4.5 × longer than width at apex (Figs 2a, 3a)	Third segment of antennae thick, 2.5–3 × longer than width at apex (Figs 2b, 3b)
Antennal segments 3–9 almost parallel sided; width of base and width of apex nearly equal (Fig. 3a)	Antennal segments 3–9 expanded at apex; base broader than apex (Fig. 3b)
Pronotum less transverse: length to width 0.8 (Table 2, Fig. 10a), with gently rounded sides, shape less variable	Pronotum distinctly transverse: length to width 0.7 (Table 2, Fig. 10b), laterally angularly widened, shape of pronotum variable
Brown specimens with wide, light brown anterior margin of pronotum	Brown specimens only rarely with light brown anterior margin of pronotum
Pubescence of pronotum light, dense, long, recumbent	Pubescence of pronotum black, sparse, short, erected
Pronotum shining with sparse puncturation (Fig. 4a)	Pronotum with dense, dull, granular puncturation (Fig. 4b)
Third segment of hind tarsus bilobed nearly to the base	Third segment of hind tarsus not bilobed in basal quarter
VII tergite of female long, apex slender, width to length 1.2 (Fig. 6a)	VII tergite of female wider than long, width to length 0.75 (Fig. 6b)
Aedeagus parallel-sided, apex distinctly swollen (Fig. 7c)	Aedeagus narrowed, conical towards apex (Fig. 7d)
Parameres short, broadly rounded at apex, with short, sparse hairs (Fig. 7a)	Parameres long, narrowed towards the apex, with long, dense hairs (Fig. 7b)
Hind wing venation as in Fig. 5a	Hind wing venation as in Fig. 5b

factor; we were not interested in differences among the countries of origin of the specimens and in addition, for some of them the sample size was very small.

However, country was taken into account as a random variable. Initially we tested for interactions between the explanatory variables, but they were non-significant and thus we did not include them into final analyses presented here. Significance of fixed effects was estimated by t-tests using Satterthwaite’s method for calculating degrees of freedom (package *lmerTest*, Kuznetsova *et al.* 2017). When reporting the test results we

used following form: $t(df) = t$ -statistic with degrees of freedom, p = significance value.

3. Results

3.1. *Asemum tenuicorne*
in the Białowieża Primeval Forest

In the Białowieża Primeval Forest (Białowieża National Park, compartment 105B, UTM: FD95), we collected one female (June 2–15, 2009, 52°48’53.89”N, 23°50’33.45”E) (Fig. 2a)

Table 2. Body proportions (ranges; means) of *Asemum tenuicorne* (At) (*n* = 46, 19♀, 27♂) and *A. striatum* (As) adults (*n* = 63, 24♀, 39♂).

Sex	Pronotal index: length/width		Elytral index: length/width	
	At	As	At	As
Males	0.7–0.9 (0.8)	0.6–0.8 (0.7)	2.2–2.6 (2.4)	2.0–2.4 (2.2)
Females	0.7–0.9 (0.8)	0.6–0.8 (0.7)	2.2–2.4 (2.3)	2.0–2.3 (2.2)
Total	0.7–0.9 (0.8)	0.6–0.8 (0.7)	2.2–2.6 (2.4)	2.0–2.4 (2.2)

Table 3. Measurements (mm, range (mean)) of adults of *Asemum tenuicorne* (At) (*n* = 46, 19♀, 27♂) and *A. striatum* (As) (*n* = 63, 24♀, 39♂).

	Males	Females	Total
Body length			
At	10.4–17.3 (13.2)	12.0–17.8 (15.1)	10.4–17.8 (13.9)
As	11.5–17.0 (13.8)	10.9–17.8 (15.3)	10.9–17.8 (14.4)
Length of right elytron			
At	6.8–11.2 (8.5)	7.4–11.4 (9.2)	6.8–11.4 (8.8)
As	7.4–11.8 (9.3)	6.5–12.5 (10.1)	6.5–12.5 (9.6)
Width of pronotum			
At	2.4–4.2 (3.1)	2.9–4.3 (3.5)	2.4–4.3 (3.3)
As	2.9–4.7 (3.7)	2.8–5.0 (4.1)	2.8–5.0 (3.8)
Length of pronotum			
At	2.0–3.1 (2.5)	2.1–3.3 (2.7)	2.0–3.3 (2.6)
As	2.1–3.3 (2.6)	2.2–3.5 (2.8)	2.1–3.5 (2.7)
Width of elytra at base			
At	2.8–4.8 (3.7)	3.3–4.8 (4.0)	2.8–4.8 (3.8)
As	3.4–5.2 (4.3)	3.2–5.5 (4.6)	3.2–5.5 (4.4)

Table 4. Differences in hind wing venation of *Asemum tenuicorne* and *A. striatum*.

	<i>Asemum tenuicorne</i>	<i>Asemum striatum</i>
Margin rf at joint with vein RA	Wide, pigmented	Not pigmented
Vein AA ₃	Well developed, H-shaped	Short, invisible, X-shaped
Veins around rc	Strongly pigmented, dark, narrow rc field	Narrow, weakly pigmented, bright, wide rc field
Vein R ₃	Long, dark, strongly pigmented	Short, light yellow
Vein RP	Long, dark, strongly pigmented, blurred	Shorter, light yellow, weakly pigmented
Vein MP ₃₊₄	Thick, darkly pigmented	Thin, brightly pigmented

and one male (May 24–June 6, 2016, 52°49' 0.35"N, 23°50'35.39"E) of *Asemum tenuicorne* in the “Netocia” barrier traps suspended on the trunks of live Scots pines *Pinus sylvestris* Linnaeus in the area of fire, leg. JMG. Both specimens belong to the form with brown elytra.

3.2. Taxonomy

Asemum tenuicorne was described by E. G. Kraatz in 1879 based on two specimens (1♀, 1♂) from Crimea. The types are stored in the collection of Senckenberg Deutsches Entomologisches



Fig. 3. Antennae of males. – a. *Asemum tenuicorne*. – b. *A. striatum*.

Institut in Müncheberg (previously the Deutsche Entomologische Institut in Eberswalde) (Sama & Bocchini 1992). Recently, a new subspecies was described from south Turkey (İçel prov.), *A. tenuicorne* ssp. *claricostulatum* Özdikmen & Aytar, 2012 (Özdikmen & Aytar 2012).

The holotype (♂) is preserved in the Entomology Department of Eastern Mediterranean Forestry Research Institute (Turkey, Tarsus, İçel prov.).

Megasemum quadricostulatum var. *semilividum* Pic, 1893: 417 (loc. typ. Amanos Mountains in Hatay province, Turkey) is an unavailable name according to Özdikmen and Aytar (2012),

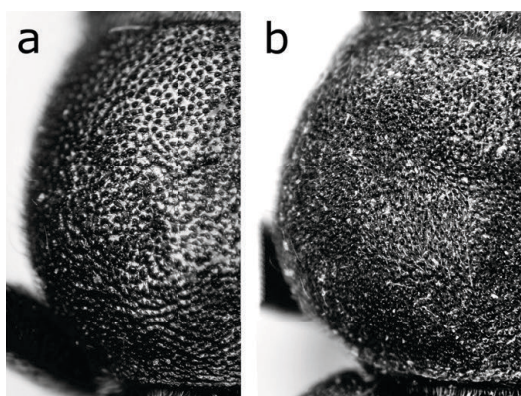


Fig. 4. Pronotal puncturation. – a. *Asemum tenuicorne*. – b. *A. striatum*.

who synonymized this with their newly described *A. t. claricostulatum* Özdikmen & Aytar, 2012.

Özdikmen and Aytar (2012) separated the new subspecies *claricostulatum* from the nominative subspecies based on the following features: clearly longer antennae, the pedicel is as long as half of the third antennal segment, the prothorax is widest below the center (2/5 distance from base) and the costae on the elytra are more visible. However, we compared photos of type *A. t. claricostulatum* with a long series of *A. t. tenuicorne* (Greece, Italy, Poland) and found no consistent differences between them; i.e., there is much natural variability in the mentioned features within this species. Sama *et al.* (2012) recently recorded *A. t. tenuicorne* from Dörtüyl (Hatay), near *loc. typicus* of *A. t. var. semilividum* Pic, 1893.

Casey (1912) described nine taxa from the genus *Asemum* mainly based on such features as the length of antennae and the shape of the prothorax, but all were subsequently synonymized. The variability of these features in the genus *Asemum* demands extreme caution in describing new taxa, especially at the level of subspecies.

3.3. Morphology

Distinguishing between adults of *A. striatum* and *A. tenuicorne* on the basis of existing keys can be difficult, and even unsuccessful, because they usually concern only few features, the interpretation of which is subjective (Plavilstshikov 1940, 1965, Pesarini & Sabbadini 1994, Bense 1995,

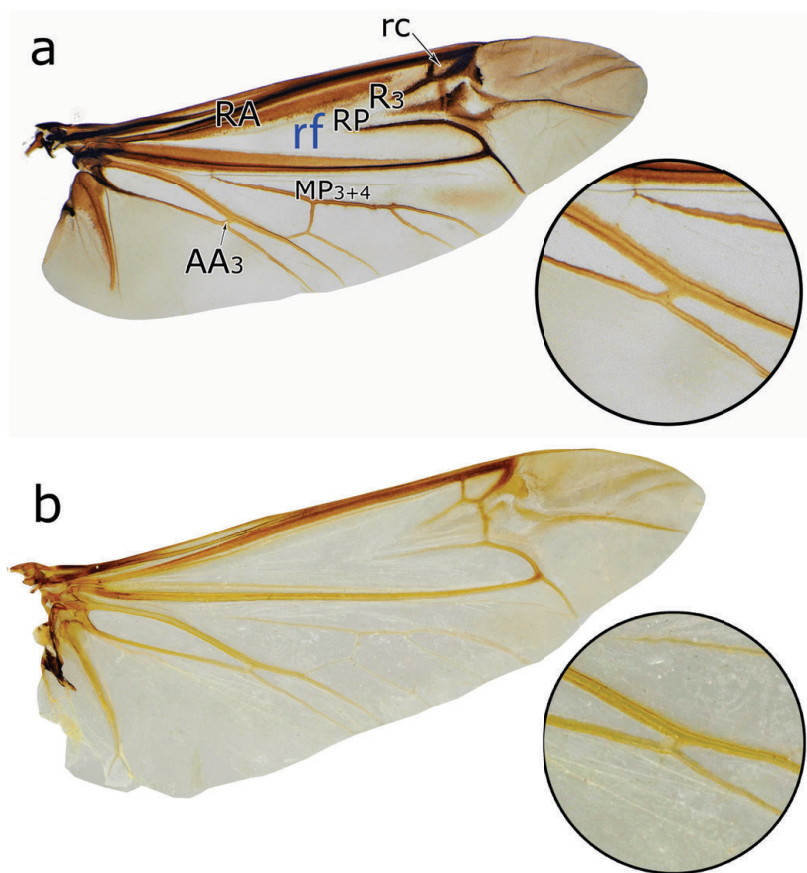


Fig. 5. Wing venation (right wing). – a. *Asemum tenuicorne*. – b. *A. striatum*. AA₃: anal anterior vein, MP₃₊₄: medial posterior vein, rc: radial cell, rf / RA: radial field at radial anterior vein, R₃: radial vein, RP: radial posterior vein. Terminology according to Kukalová-Peck and Lawrence (1993, 2004).

Bílý & Mehl 1989). A somewhat more detailed key was provided by Sama and Bocchini (1992). The important features of *A. tenuicorne* are given in the description of Kraatz (1879). Specimens of both species are very variable (e.g. Fig. 2), which may make identification difficult. Based on the study of several dozen specimens of *A. striatum* and *A. tenuicorne* from different locations, and verification of the features given in the literature, we provide the most useful diagnostic features in the key in Table 1 and Figs 2–7.

The series of *A. tenuicorne* (19♀, 7 black and 12 brown and 27♂, 15 black and 12 brown) and *A. striatum* (24♀, 39♂) were compared (Tables 2–4). The species have overlapping size, but they differ in all the metric features included here. The average body length, without separating sexes, of *A. tenuicorne* (13.92 mm, *SD* = 1.98 mm) is slightly, but significantly, less than that of *A. striatum* (14.4 mm, *SD* = 1.59 mm; GLMM, $t(15.549) = -2.420$, $p = 0.028$; Table 3). Females

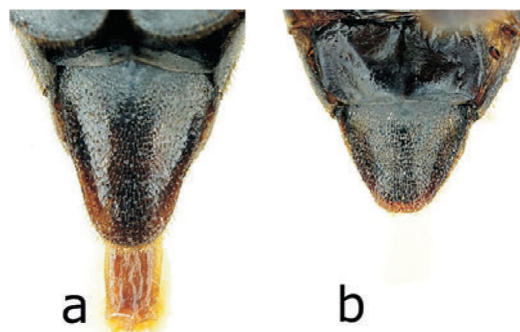


Fig. 6. VII sternite of female. – a. *Asemum tenuicorne*. – b. *A. striatum*.

are slightly larger than males in both species (GLMM, $t(101.599) = -4.319$, $p < 0.001$ for *A. striatum*, and $t(100.287) = -3.700$, $p < 0.001$ for *A. tenuicorne*).

There was a statistically significant difference in body length in males *A. striatum* being slightly larger than *A. tenuicorne* (GLMM, $t(10.296) = 2.559$, $p = 0.028$; Table 3, Figs 8, 9). In the gen-

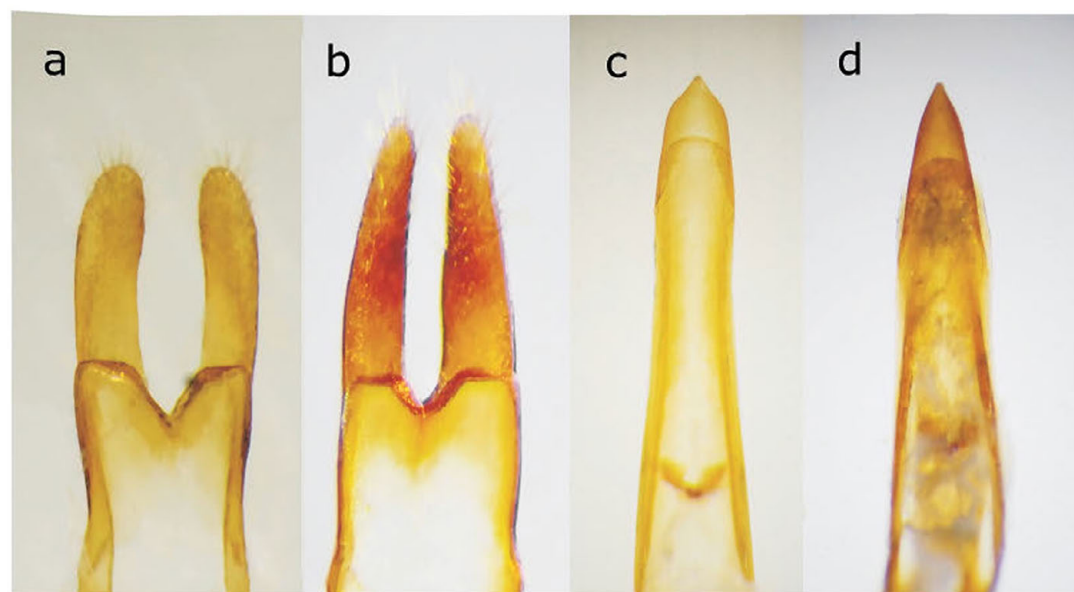


Fig. 7. Male copulatory organs: aedeagus and parameres. – a, c. *Asemum tenuicorne*. – b, d. *A. striatum*.

eral outline of the body, *A. tenuicorne* is slightly slimmer than *A. striatum* (elytra length / elytra width = 2.4) and it also has less transverse prothorax (length / width of the prefix = 0.8), whereas in *A. striatum* these values are respectively 2.2 and 0.7 (Table 2, Figs 9, 10). The differences between *A. tenuicorne* and *A. striatum* were statistically significant for both in elytra length/width ratio (GLMM, $t(6.678) = 2.575, p = 0.038$) and in prothorax length/width ratio (GLMM, $t(3.940) = 7.234, p = 0.002$).

The length of the left and right elytron in both species differed in some cases (fluctuating bilateral asymmetry), but these differences were slight, and there were too few specimens to perform a statistical analysis.

Wing venation may be a good diagnostic feature at the level of subfamilies (Vives *et al.* 2008), tribes, genera and also between species (Tian *et al.* 2013, Huang & Chen 2016). After examining a series of specimens of *A. tenuicorne* and *A. striatum*, distinguishing features were found.

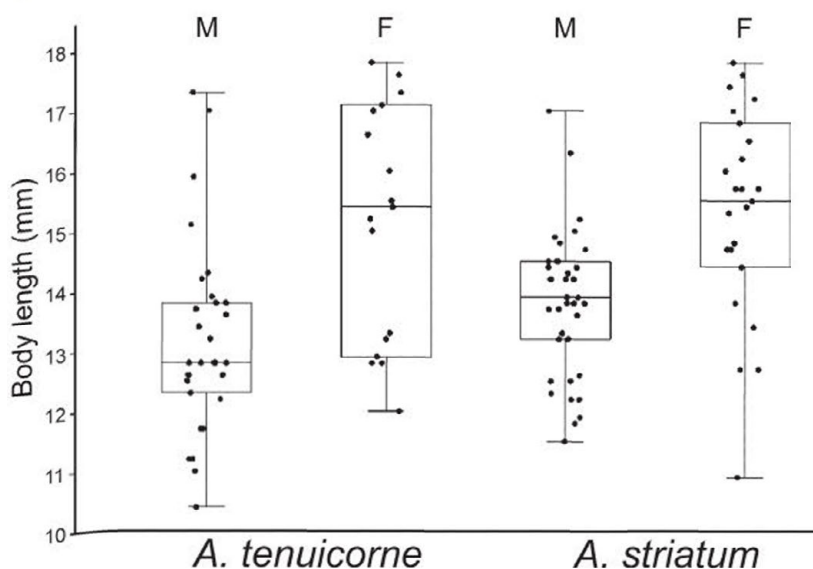


Fig. 8. Body lengths of *Asemum tenuicorne* and *A. striatum* males (M) and females (F). Medians, standard deviations (boxes) and ranges are shown. Differences between species and sexes are statistically significant, see section 3.3.

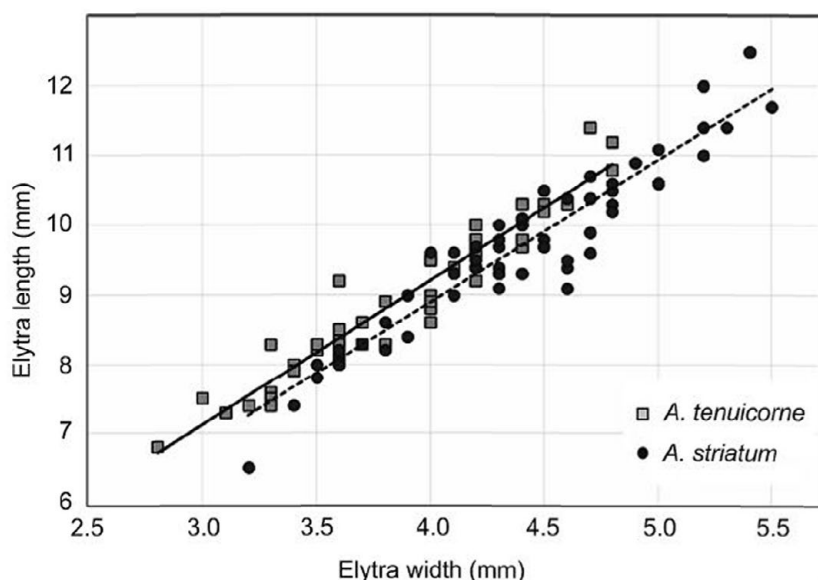


Fig. 9. Body proportions (length of elytra to width) of *Asemum tenuicorne* and *A. striatum*.

Asemum tenuicorne has a clearly darker wing picking thanks to the more developed pigmentation of the veins. In addition, the shape of the vein AA_3 is different in these species (Table 4, Fig. 5).

The larva of *A. tenuicorne* was described by Mamaev and Danilevsky (1973) and completed by Švácha and Danilevsky (1987). The larvae are up to 20 mm long and 4 mm wide. They are easily distinguished from *A. striatum* by the urogomphi: those of *A. tenuicorne* are twice as long as their width at the base (in *A. striatum*, the length is equal to the width of the base), curved towards the front of the body (in *A. striatum* they are straight), and more strongly pigmented than those of *A. striatum*, i.e. the more heavily chitinized parts are browner. The egg and pupal stages have not been described yet.

3.4. Biology

Biology of *A. tenuicorne* is similar to that of *A. striatum* (Plavilstshikov 1940, Švácha & Danilevsky 1987, Bense 1995).

The flight period is from May to July (Danilevsky & Miroshnikov 1985, this study). Adults are active at dusk and at night (Lundberg 1981, Calvo Sánchez 2016, M. Szweczyk, this study) but they can also be found during the day in the cracks in the bark (Sama & Bocchini 1992, this study).

Host plants of larvae are *Pinus nigra* (Sama &

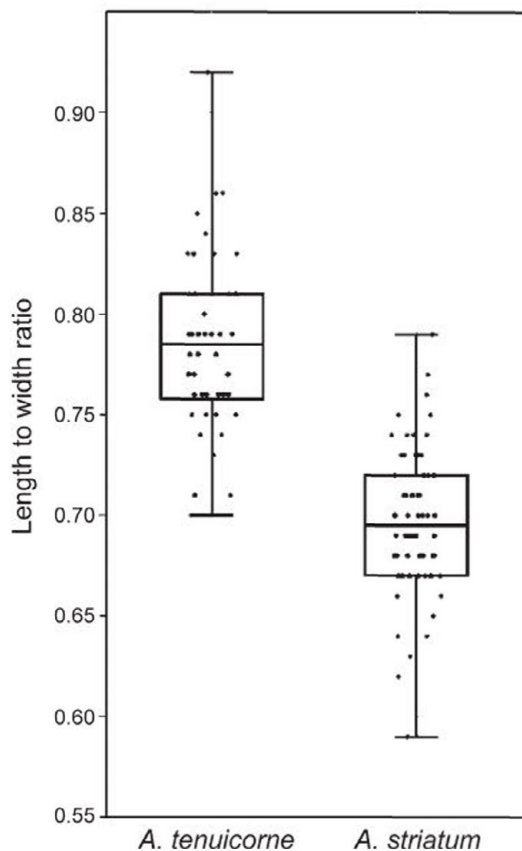


Fig. 10. Length to width ratio of prothorax of *Asemum tenuicorne* and *A. striatum*. Medians, standard deviations (boxes) and ranges are shown. Difference between species is statistically significant, see section 3.3.

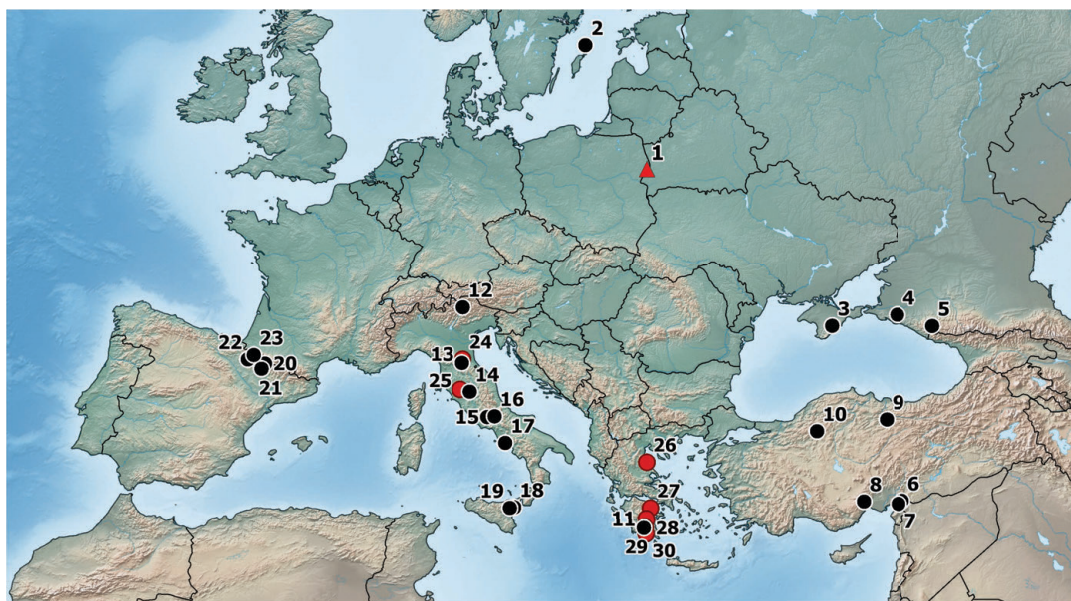


Fig. 11. Distribution of *Asemum tenuicorne* (red triangle: new record for fauna of Poland, black circle: literature data, red circle: new data, this study; *: this study). *1: PL, Białowieża Primeval Forest, 2: SE, Gotska Sandön (Heqvist 1955, Palm 1955, Lundberg 1981, Bilý & Mehl 1989), 3: UK, Crimea (*locus typicus*) (Kraatz 1879), 4: RU, Ubinskaya (Mamaev & Danilevsky 1973, Švácha & Danilevsky 1987), 5: RU, Adygea, Gora Dzhuga (Miroshnikov 2011), 6: TR, Akbez (Pic 1893), 7: TR, Dörtyol (Sama *et al.* 2012), 8: TR, Dikenlioluk (*loc. typ. A. t. claricostulatum* Özdikmen & Aytar, 2012), 9: TR, Tokat (Sama & Bocchini 1992), 10: TR, Kızılcıhamam (Demelt 1967), 11: GR, Taygetos (Sama & Bocchini 1992, Danilevsky 2014), 12: IT, Bolzano (Kraatz 1887), 13: IT, Marradi (Sama & Bocchini 1992, this study), 14: IT, Mt. Peglia (Sama 2005), 15: IT, Colleparado, Certosa di Trisulti (Gobbi 2002), 16: IT, Pescasseroli (Gobbi 2002), 17: IT, Mt. Faito (Sama & Bocchini 1992), 18: IT, Sicilia, Linguaglossa (Sparacio *et al.* 2003, Baviera 2006), 19: IT, Sicilia, Piano Provenzana, Rifugio Ragabo (Rapuzzi & Sama 2006), 20: SP, Valle de Ordesa, Oto de Broto (González Peña *et al.* 2007), 21: SP, Aineto (Murria Beltrán *et al.* 2013), 22: SP, Sierra de Leyre, Sierra de Ilion, Navarra (Calvo Sánchez 2016), 23: SP, Isaba Mt. Txamantxoia, Valle de Roncal, Navarra (Recalde Iurzun & San Martín Moreno 2017), 24: IT, Casola Valsenio, 25: IT, Monte Amiata, 26: GR, Mt. Ossa, 27: GR, Peloponnese, Taygetos mts. (incl. Agios Vasileios), 28: GR, Peloponnese, Ellada, 29: GR, Peloponnese, Paleopanagia, 30: GR, Peloponnese, Neochori.

Bocchini 1992, Sama *et al.* 2012, this study), *P. nigra* var. *calabrica* (Loudon) C.K. Schneid. (Baviera 2006, Rapuzzi & Sama 2006), *P. nigra* var. *corsicana* (Loudon) Hyl., *P. heldreichii* H. Christ (BioLib 2016), *Pinus* (Mamaev & Danilevsky 1973, Danilevsky & Miroshnikov 1985, Bense 1995, Sláma & Slámová 1996), or conifers in general (Danilevsky & Miroshnikov 1985). According to Sama (2002), *A. tenuicorne* is monophagous on pine, and in Sweden and Poland most likely develops on *P. sylvestris*, because this

is the only species of pine there. Eggs are laid on freshly dead trees (Sama 2002) and development to adults takes at least two years (Danilevsky & Miroshnikov 1985).

The habitat, in which the specimens of *A. tenuicorne* were caught in the Białowieża Primeval Forest, is shown in Fig. 1. The first specimen was caught in the year of a forest fire and the second one seven years after the fire. In spite of targeted searches, we could not find the larvae of this species and their feeding places.

So far, no parasitoid species of *A. tenuicorne* have been found. On the other hand, a case of predation has been recorded – one dead specimen was found on a wood belt in a web of an unspecified spider species (Greece, Peloponnese, Taygetos mts., SE Artemisia, M. Szewczyk, pers. comm.). Among the studied specimens of *A. tenuicorne*, we found (Greece, Peloponnese, Taygetos: Neochori, 27.V.2010) a specimen, on the body of which numerous deutonymphs of *Trichouropoda* sp. (Acarina: Mesostigmata: Uropodina) (det. J. Błoszyk) were observed attached to pro- and metafemur (phoresy).

3.5. Geographical distribution

The main sources summarizing the distribution of *A. tenuicorne* are published in the works of Sama and Bocchini (1992), Rapuzzi & Sama (2006) and Danilevsky (2014). The current distribution of *A. tenuicorne* over the whole range is shown on a map (Fig. 11).

This species is known primarily from the south of Europe, southwest Asia but also from isolated localities in **Sweden** (Gotska Sandön island: Heqvist 1955, Palm 1955, Lundberg 1981, Bílý & Mehl 1989) and **Poland** (Białowieża Primeval Forest, this study). It has been reported from the following countries: **Spain** (Aragón in the Pyrenees (Vives 1984, González Peña 2002, González Peña *et al.* 2007), Navarra (Calvo Sánchez 2016, Recalde Irurzun & San Martín Moreno 2017)); **Italy** (Romagna toscana: Marradi (Sama & Bocchini 1992, this study), Emilia-Romagna: Casola Valsenio (this study), Toscana: Monte Amiata (this study), Umbria: Monte Peglia (Sama 2005), Lazio: Collepardo, Monti Ernici: Certosa di Trisulti (Gobbi 2002), Abruzzo: Pescasseroli (Gobbi 2002), Campania: Monte Faito (Sama & Bocchini 1992), Sicilia: Etna, Linguaglossa (Sparacio *et al.* 2003, Baviera 2006, Sama & Rapuzzi 2011), Rifugio Ragabo, Piano Provenzana (Sama & Rapuzzi 2011), Alto Adige: Bolzano (South Tirol, Bozen) (Kraatz 1887, Bertolini 1904, Heyden *et al.* 1906, Schilsky 1909, Plavilstshikov 1940)); **Greece** (Peloponnese, Mount Taygetos (Sama & Bocchini 1992, Sláma & Slámová 1996), Peloponnese: Artemisia, Agios Petros, Paleopanagia, Neochori (this study), Thessaly: Mount

Ossa (this study)); **Turkey** (Ankara, Hatay (Demelt 1967), Tokat (Sama *et al.* 2012), Akbeş (Kraatz 1879), Ýçel (Özdikmen & Aytar 2012)); **Georgia** (Löbl & Smetana 2010); **SW Russia** (Ubinskaja, Krasnodarskij Kraj (Mamaev & Danilevsky 1973, Švácha & Danilevsky 1987), Adygea, Gora Dzhuga (Miroshnikov 2011)); **SE Ukraine** (Crimea (Kraatz 1879, Plavilstshikov 1940).

The information on the occurrence of this species in Romania (Löbl & Smetana 2010) is based on data with no references (Danilevsky 2014) and should therefore be removed from the list of species of this country. Several localities of *A. tenuicorne* based on Plavilstshikov's data are highly doubtful: Russia, Glavnyj Kavkazskij Chrebet (Plavilstshikov 1940), Armenia, Giumri (Plavilstshikov 1948) and Turkey, Sarikamış (Plavilstshikov 1927), Kars (Plavilstshikov 1931, 1940)). "*N.N. Plavilstshikov wrongly regarded brown specimens of A. striatum (often very big!) from Russia, Teberda as A. tenuicorne. A big series of such specimens is preserved in his collection in Moscow and is available for study*" (Danilevsky 2014, pers. comm.). Also, occurrence in Estonia (Murria Beltrán *et al.* 2013) is an evident mistake, and is not based on any documented findings.

Aseum tenuicorne has been sometimes confused with *A. striatum* (Baviera *et al.* 2005) and with *Tetropium fuscum* (Sánchez & Tolosa 1998). However, both the recent literature information and the collected specimens indicate that *A. tenuicorne* is not as rare in its appropriate habitats as it seemed to date.

4. Discussion

Aseum tenuicorne was not previously known from Poland (Gutowski 2005, Kurzawa 2017) and its geographical range (south of Europe and the island of Gotska Sandön in Sweden) did not suggest that it would be present there. The second species of this genus, *A. striatum*, which occurs uncommonly but regularly in Poland, is known from the Białowieża Forest. In other regions of Poland, where pine forests dominate, *A. striatum* sometimes appears numerous and is often noted as a physiological and technical pest of conifers, especially pines (Dominik 1962).

It may be discussed whether or not the populations from the Białowieża Primeval Forest, separated from the main range, and especially from Sweden, belong to a separate taxon, as suggested by Švácha and Danilevsky (1987). However, M. Sláma mentions (Sláma & Slámová 1996) that he saw specimens from Gotska Sandön and confirms that they belong to *A. tenuicorne*. The specimens from the Białowieża Primeval Forest do not show differences in relation to the South European ones. There are no known details of *A. tenuicorne* biology, particularly the differences in preferences regarding the environment and microenvironment in relation to the common *A. striatum*, hence the potential habitat of *A. tenuicorne* larvae is difficult to predict. It is known from literature (Dominik 1962, Lundberg 1984) that *A. striatum* is a pyrophilous species. Probably *A. tenuicorne* can also be classified as such, because it is mainly associated with pines that tolerate ground-level fires and often fire improve the conditions for their effective renewal, because it eliminates competing species of trees (spruce, deciduous species), which are more sensitive to fire (Niklasson *et al.* 2010).

This is also confirmed by the circumstances of collecting the specimens originating from the southern part of the species range that we had at our disposal at the time of writing this work. One specimen was found in Greece, in the Peloponnese, under the bark of black pine *Pinus nigra* F. Arnold killed by fire (J. Tatur-Dytkowski leg.), and about 80 specimens that were collected on the logs of pine wood obtained from the extensive fire on this peninsula (J. Kalisiak, M. Kaźmierczak and M. Szewczyk leg.).

How did *A. tenuicorne* become established in the Białowieża Primeval Forest and the Gotska Sandön, both of which are clearly isolated from the main range? Colonization of these regions by *A. tenuicorne* must have occurred after the last glaciation at the end of the Pleistocene (Białowieża Primeval Forest) or during the Holocene (Gotska Sandön). Subfossil remains of this species in these locations in the last 12,000 years would clarify things but no such remnants have been found to date (Pawłowski 1989, Whitehouse 2006). However, early fossil records of other beetle species of similar biology related to Scots pine are plentiful. For example, the earliest

records are: *Acanthocinus aedilis* (Linnaeus) 6,050 BP (Finland); *Arhopalus rusticus* (Linnaeus) 6,200 BP (Finland); *Hylastes angustatus* (Herbst) and *H. ater* (Paykull) 9,340 BP (Ireland); *Pissodes piniphilus* (Herbst) 5,900 BP (Finland); *Rhyncolus elongatus* (Gyllenhal) 10,650 BP (Great Britain), 8,500 BP (Ireland); and *R. sculpturatus* Walzl 5,350 BP (United Kingdom), 8,500 BP (Ireland) (Koponen & Nuorteva 1973, Whitehouse 2006).

We suggest that *A. tenuicorne* should be regarded as a native species in Poland, because its introduction or recent arrival in the Białowieża Primeval Forest area is unlikely due to the compact, large area of the habitat, favorable conditions for its distribution, and its isolation from the nearest other known localities of this species in southern Europe and Sweden. The main host plant of *A. tenuicorne*, *Pinus* spp., has existed in Poland for 14,000 years and reached a peak during the period of 11,000–9,000 BP (Allerød – beginning of the Holocene) (Latałowa *et al.* 2004). Pine occurred throughout the Holocene, but its prominence in the forests of Poland oscillated, and was lowest during the Atlantic and Subboreal periods, when deciduous species predominated. From about 3,000 BP, the amount of pine pollen in sediments began to increase, especially in the north-eastern part of Poland.

This process intensified in the last millennium, and is undoubtedly related to the industrialization of the country (Latałowa *et al.* 2004) and greater frequency of anthropogenic, ground-level forest fires (Niklasson *et al.* 2010). Fires, which are very favorable for the renewal of pine in the forests, also occurred without human influence in European landscapes in medium latitudes (not only in the south and in the north, as it is now), as evidenced by numerous coal particles found in early Holocene sediments (Whitehouse 2006).

Beetles associated with pine, including probably *A. tenuicorne*, inhabited these areas also in earlier times, e.g. in the interstadials of the Pleistocene (Cope 1965, Elias 2010), but subsequent glaciations displaced these species to refugia, from where they returned to their former areas. Taking these considerations into account, the colonization of the northern localities of this species might most probably have happened right after the last glaciation, during the period of maximum

representation of pine in the landscape, i.e. 11–9,000 BP (Latalowa *et al.* 2004, Kullman & Kjällgren 2006). Niklasson (2015), who researched the history of the fires at Gotska Sandön, states that the behaviour of *A. tenuicorne* and several other rare beetles on the island should be attributed to the lower intensity of forest use, frequent fires, open forest structure and a large amount of dead wood. On the land, in southern Sweden, these species probably became extinct over 150 years ago as a result of the human economy, before entomologists could register them.

We disagree with the prevailing opinion that this and other unique species of beetles preserved are relics of the warmer (Atlantic) Holocene period and claims that they arrived in Sweden, including this island, much earlier. In the Central European forests, which were intensively used in the historical period, and later forest management was carried out, the species became extinct. It remained only in the best preserved, long-protected remnants of natural forests with considerable shares of pine, as in the above-mentioned cases. This species is considered a forest relic (Palm 1955). It may be found in similar, best-preserved forests in Eastern Europe, which are not yet well researched.

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