

Article

The American Tribes Anypotactini and Eudiagogini (*Coleoptera*, *Curculionidae*) in Eocene of Europe as Indicators of Eocene Climate with Description a New Species

Andrei A. Legalov ^{1,2,3,*} , Dmitry V. Vasilenko ^{4,5} and Evgeny E. Perkovsky ⁶

¹ Institute of Systematics and Ecology of Animals, Siberian Branch, Russian Academy of Sciences, 630091 Novosibirsk, Russia

² Department of Ecology, Biochemistry and Biotechnology, Altai State University, 656049 Barnaul, Russia

³ Department of Forestry and Landscape Construction, Tomsk State University, 634050 Tomsk, Russia

⁴ Laboratory of Arthropods, A. A. Borissiak Paleontological Institute of the Russian Academy of Sciences, 117647 Moscow, Russia

⁵ Paleontological Laboratory, Cherepovets State University, 162600 Cherepovets, Russia

⁶ Department of Entomology and Collection Management, I. I. Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine, 01030 Kiev, Ukraine

* Correspondence: fossilweevils@gmail.com

Abstract: From the modern distribution of the tribes Anypotactini and Eudiagogini (*Coleoptera*, *Curculionidae*), it can be assumed that the climate of the late Eocene amber forests was similar to that of the Valdivian temperate forests. A new species, *Paonaupactus zosimovichi* sp. n. from the tribe Anypotactini of the subfamily Entiminae is described from Late Eocene Rovno amber. It differs from *Paonaupactus gracilis* by its rarer, decumbent scales on the elytral interstriae, elytral interstriae, which are clearly visible between scales, and its smaller body size. This is the third species of the genus *Paonaupactus* found in Rovno amber.

Keywords: Entiminae; *Paonaupactus*; new species; distribution; Eocene climate; Paleogene; Rovno amber



Citation: Legalov, A.A.; Vasilenko, D.V.; Perkovsky, E.E. The American Tribes Anypotactini and Eudiagogini (*Coleoptera*, *Curculionidae*) in Eocene of Europe as Indicators of Eocene Climate with Description a New Species. *Diversity* **2022**, *14*, 767. <https://doi.org/10.3390/d14090767>

Academic Editors: Natalia Kirichenko and Vyacheslav Martemyanov

Received: 25 August 2022

Accepted: 14 September 2022

Published: 16 September 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

The genus *Paonaupactus* Voss, 1953 belongs to the tribe Anypotactini and includes seven species from European Eocene ambers [1–4]. Initially, species of this group were described in the extinct genera *Paonaupactus* and *Protonaupactus* Zherikhin, 1971 (tribe Naupactini), and *Sucinophyllobius* Wanat & Borowiec, 1986 (tribe Phyllobiini), or assigned to extant genera *Polydrusus* Germar, 1817, *Phyllobius* Germar, 1823, and *Otiorhynchus* Germar, 1822, respectively, in the tribes Polydrusini, Phyllobiini, and Otiorhynchini [5–8]. Subsequently, the genus *Paonaupactus* was placed in the tribe Anypotactini [1]. The names *Sucinophyllobius* and *Protonaupactus* were synonymized with *Paonaupactus* [3,9]. Here, we describe a new species of the genus *Paonaupactus* from late Eocene Rovno amber, the third of this genus in Rovno amber.

2. Materials and Methods

The amber piece with a new species was found between Voronki and nearby Luko [10,11] in the Varash district of Rivne Oblast.

The studied specimens were deposited in the amber collection of the Schmalhausen Institute of Zoology of the National Academy of Sciences of Ukraine, Kiev (SIZK), Museum of Amber Inclusions, University of Gdańsk, Poland (MAIG) and the Institute of Systematics and Ecology of Animals, Siberian Branch, Russian Academy of Sciences, Novosibirsk (ISEA).

Images were taken using a Leica Z16 APO stereomicroscope equipped with a Leica DFC 450 camera (Leica Microsystems, Wetzlar, Germany).

The morphological terminology used in this paper follows Lawrence et al. [12].

Nomenclatural acts introduced in the present work are registered in ZooBank (www.zoobank.org) under LSID urn:lsid:zoobank.org:pub:54BE23FB-E3AA-4F04-9317-F315F2B02965.

3. Results

Systematic Paleontology

Family **Curculionidae** Latreille, 1802

Subfamily **Entiminae** Schoenherr, 1823

Tribe **Anypotactini** Champion, 1911

Genus ***Paonaupactus*** Voss, 1953

Paonaupactus zosimovichi Legalov, Vasilenko & Perkovsky, **sp. n.** (Figure 1)

LSIDurn:lsid:zoobank.org:act:66BF4F73-5795-43C0-A53B-59CBEE980C0F

Description. Size. Length without rostrum 3.8 mm, rostrum length 0.6 mm. Body black, covered with dense greenish scales. Rostrum weakly widened at apex, punctate. Rostrum about twice as long as wide at middle, about 1.2 times shorter than pronotum. Mandibles massive, with scar of deciduous process. Apex of rostrum with carina forming posterior edge of large epistoma. Eyes oval, strongly protruding from head, roughly compound, about 1.3 times as long as wide at middle. Forehead slightly wider than base of rostrum, flattened, with median line. Temples 0.9 times as long as eye, transversely wrinkled. Antennal scrobes lateral. Antennae inserted slightly behind middle of rostrum. Scape elongated, extending beyond anterior margin of pronotum, about 11.2 times as long as wide at apex. Antennal is compact, fusiform. Pronotum bell-shaped, densely wrinkly-punctured, rather wide. Elytra elongated, convex. Elytra about 3.7 times as long as pronotum. Humeri slightly flattened. Elytral interstriae barely convex, with 3–4 rows of semierect narrow scales. Surface of interstriae clearly visible between scales. Interstriae 3.3–4.0 times as wide as striae. Striae distinct and deep. Prosternum without postocular lobes. Metaventrite about 2.7 times as long as metacoxa. Abdomen convex. Ventrites located almost in the same plane. First and second ventrites long. First ventrite 1.7 times as long as metacoxa. Second ventrite 0.9 times as long as first ventrite. Femora thickened, without teeth. Metafemora about 4.7 times as long as maximum width. Tibia almost straight, flattened, slightly widened at apex, without mucro and uncus. Metatibial corbels open. Protibiae about 11 times as long as wide. Metatibia about 17 times as long as wide. Tarsi elongated. First tarsomere elongate-trapezoid. Second tarsomere trapezoid. Third tarsomere bilobed. Fifth tarsomere elongated. Claws free, without teeth. First protarsomere 3.1 times as long as wide at apex. Second protarsomere 1.6 times as long as wide at apex, 0.6 times as long as first protarsomere. Width of second protarsomere about 1.1 times as wide as first protarsomere. Third protarsomere 0.8 times as long as wide at apex, 0.9 times as long as and 1.8 times as wide as second protarsomere. Fifth protarsomere 5.7 times as long as wide at apex, twice as long as third protarsomere and approximately 0.3 times as wide.

Material examined. Holotype (SIZK L-960), female, Rovno amber.

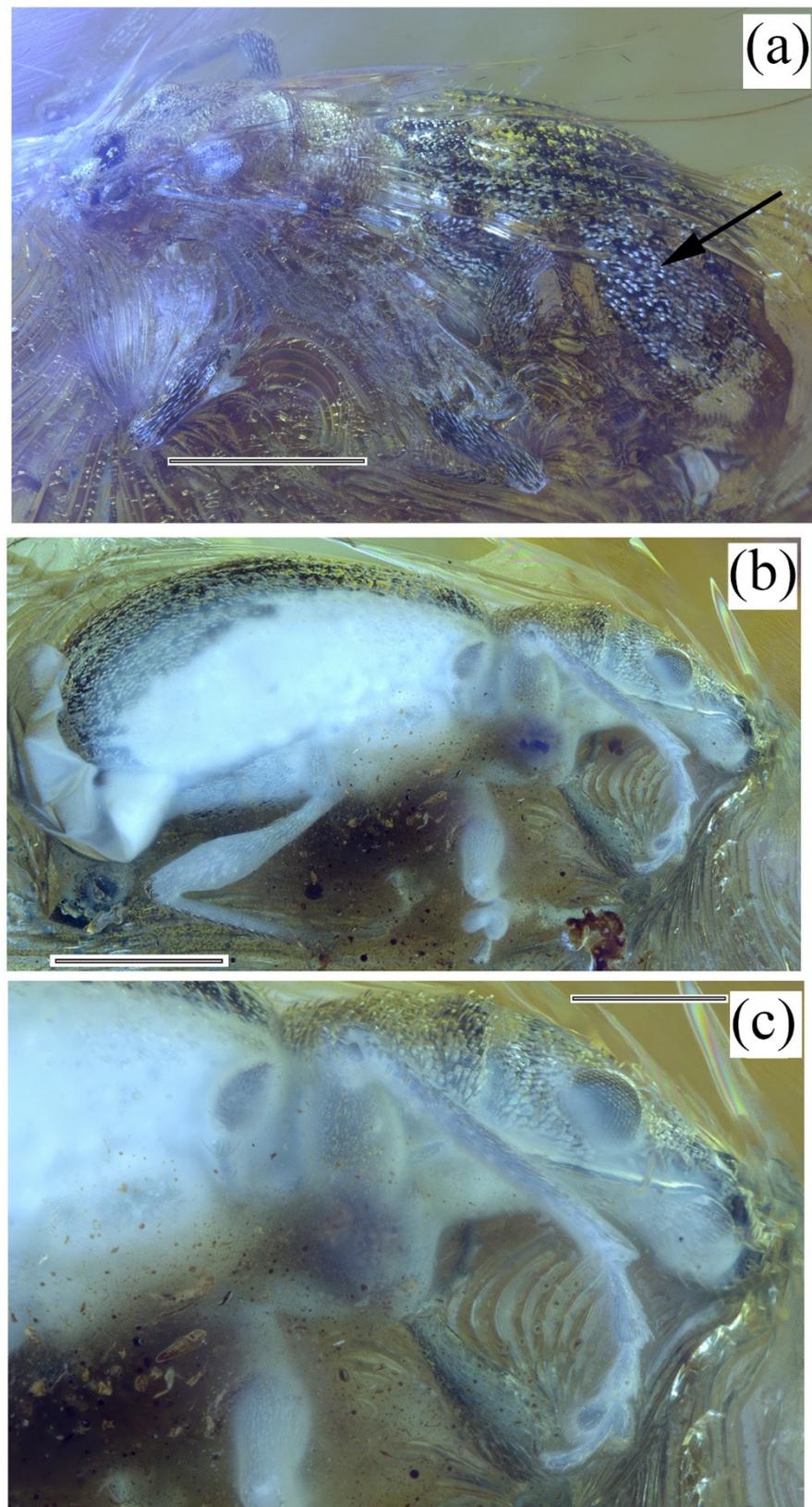


Figure 1. *Paonaupactus zosimovichi* sp. n., holotype: (a) general view, dorsolateral view, left; (b) general view, side view, right; (c) front part of the body, side view, right. Scale bar = 1.0 mm for (a,b), 0.5 mm for (c). Arrow shows scales on elytral interstriae.

Derivation of name. The species is named in honor of outstanding Ukrainian stratigrapher and author of the concept of Subparatethys, Vladimir Yurievich Zosimovich (1933–2022).

Diagnosis. The new species is very close to *Paonaupactus gracilis* Legalov, Nazarenko & Perkovsky, 2019, but is well distinguished by the rarer, semierect scales on the elytral interstriae and elytral interstriae, which are clearly visible between the scales, as well as the smaller body size. **Remarks.** The new species belongs to the subfamily Entiminae because it is characterized by massive mandibles with a scar of deciduous process, a short rostrum, and tibiae without uncus. The apex of the rostrum with a carina forming posterior edge of the large epistoma, free claws, lateral antennal scrobes, and prosternum without postocular lobes indicate that the new species belongs to the tribe Anypotactini. The open corbels of the metatibia allow it to be placed in the genus *Paonaupactus*.

Paonaupactus katyae Legalov, Nazarenko and Perkovsky, 2019 (Figure 2)

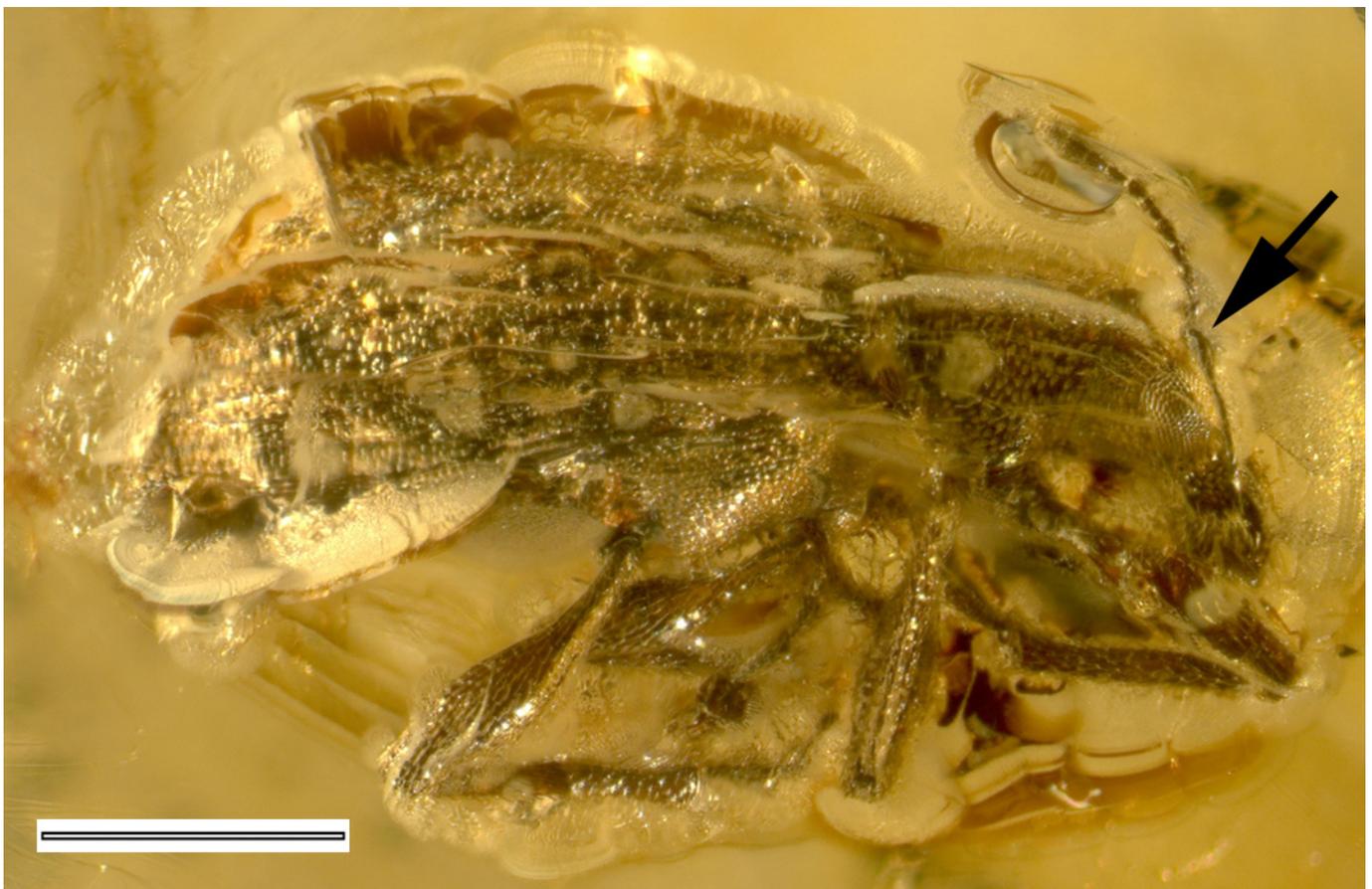


Figure 2. *Paonaupactus katyae*, holotype. Scale bar = 1.0 mm. Arrow shows apex of antennal scape.

Material examined. Holotype MAIG, 5981, Rovno amber.

Paonaupactus gracilis Legalov, Nazarenko et Perkovsky, 2019 (Figure 3)

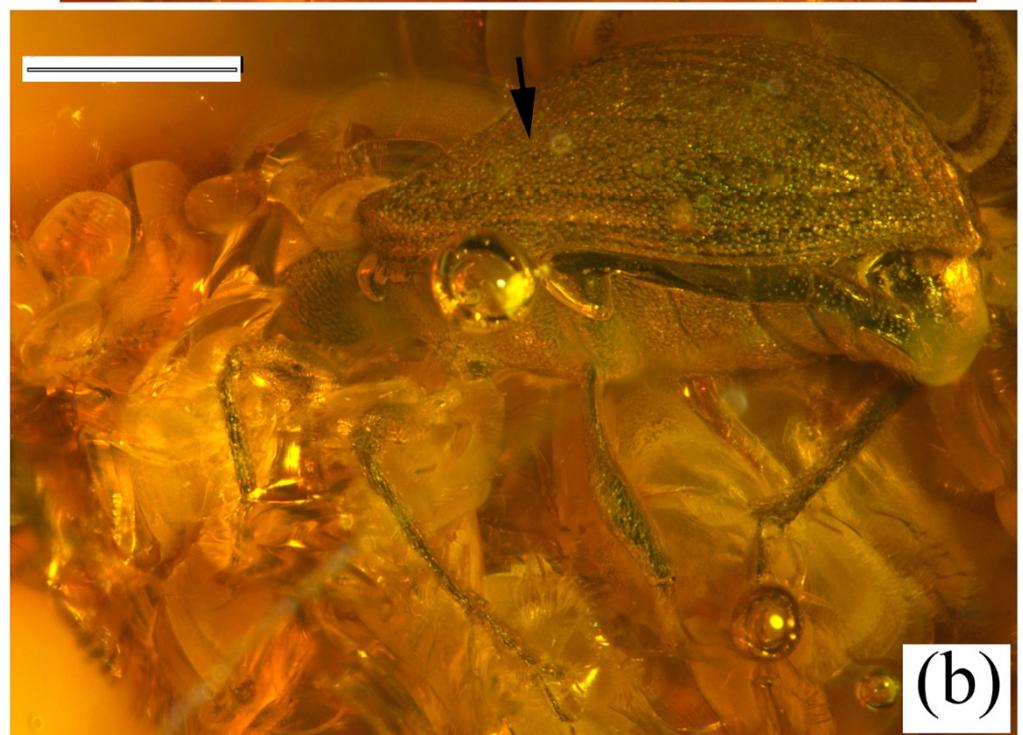
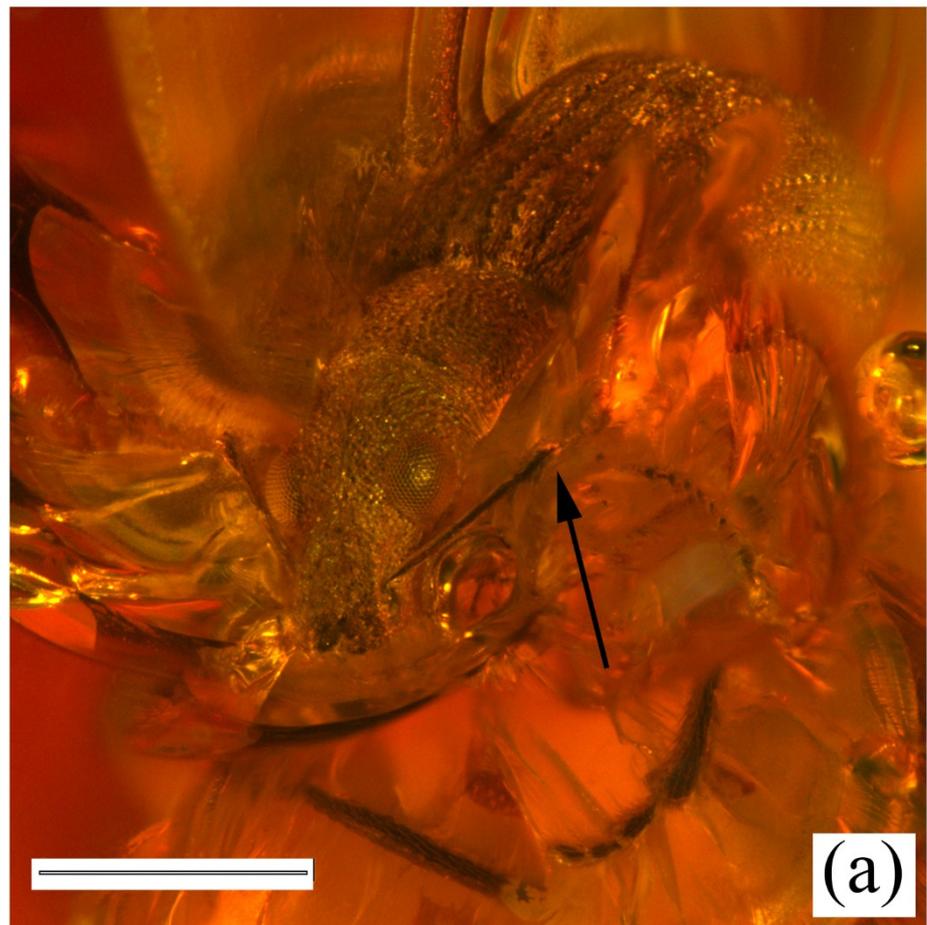


Figure 3. *Paonaupactus gracilis*, holotype: (a) general view frontal view and lateral view; (b) general view, lateral view. Scale bar = 1.0 mm. Arrow (a) shows apex of antennal scape. Arrow (b) shows scales on elytral interstriae.

Material examined. Holotype SIZK, K-647, Klesov, Rovno amber. Paratype, SIZK, UA-1139, Rovno amber. Specimens RA2021/1 (ISEA), Rovno amber and RA2021/2 (ISEA), Rovno amber.

Key to species of the genus *Paonaupactus* of Rovno amber

1. Antennal scape barely extending beyond posterior margin of eye (Figure 2). *P. katyae*.
2. Antennal scape protruding beyond anterior margin of pronotum (Figure 3).
3. Scales on elytral interstriae denser, almost contiguous. Elytral interstices between scales almost invisible (Figure 3). Body larger (4.2–4.3 mm). *P. gracilis*.
4. Scales on elytral interstriae more sparse, semierect. Elytral interstices between scales clearly visible (Figure 1). Body smaller (3.8 mm). *P. zosimovichi* sp. n.

4. Discussion

It has been assumed that the low representation of Baltic amber beetle species in Rovno amber is an artefact of insufficient sampling [13]. Current knowledge based on larger numbers of specimens, however, could indicate that it reflects a real community difference with only two new species in common [14,15], while there are over a dozen and a half new species known only from Rovno amber [16–30], including 15% in common with Baltic amber. In contrast, the well-studied Trichoptera of Baltic and Rovno ambers have 32.4% [31–34] and non-ant hymenopterans have 32% [35–38] shared species.

Species of the genus *Paonaupactus* agree with this pattern; three are known from Rovno amber (*P. gracilis* Legalov, Nazarenko & Perkovsky, 2019, *P. katyae* Legalov, Nazarenko & Perkovsky, 2019, and *P. zosimovichi* sp. n.), and four are known from Baltic amber (*P. microphthalmus* (Zherikhin, 1971), *P. sitonitoides* Voss, 1953 (= *Polydrosus scheelei* Voss, 1953, = *Phyllobius cephalotes* Voss, 1972, = *Otiorhynchus pellucidipes* Voss, 1972), *P. sobrinus* (Voss, 1972), and *P. viridis* (Wanat & Borowiec, 1986)), collected in Yantarny (Russia), and Gdańsk region (Poland). Two Baltic amber *Paonaupactus* species were also found in Danish amber from the west coast of Jutland. There are no common species between Baltic and Rovno ambers, despite the fact that species of the genus account for 30% and 50% of the weevils in unbiased collections of Rovno and Danish amber. It is difficult to accurately estimate the abundance of *Paonaupactus* in Baltic amber. This cannot be compared with Baltic amber, which is subject to collecting bias of private collectors for “interesting” and rare taxa (see Dlussky and Rasnitsyn [39] and Perkovsky et al. [40]). Species of *Paonaupactus* and *Electrotribus* Hustache, 1942, are the most common weevils in the amber collections of the Kaliningrad Regional Amber Museum and the National Museum of Natural History (Paris), as well as in online stores and auctions. They make up 100% of all weevils in the unbiased Giecewicz collection of the Museum of the Earth in Warsaw [41]. Thus, despite this collecting bias, *Paonaupactus* were undoubtedly the dominant leaf weevils at least in the late Eocene of Northern and Eastern Europe, and we believe that the observed absence of shared species of this genus in Rovno and Baltic ambers results from a real community difference and indicates a real difference in terrestrial environments affecting them more than, e.g., ants [39,42].

Today, the tribe Anypotactini (Figure 4), which includes 14 extant genera, is distributed in Central America north to the southeast of the USA (Texas), on most islands of the West Indies, in the Northern Andes (mainly on the eastern slopes), in southeastern Brazil, and in the Valdivian region of Chile [1]. This distribution is relictual; their fossils are only known in the late Eocene ambers of Europe and not in the rich Eocene Lagerstätten of the Green River Formation and Florissant Formation, nor in Miocene Dominican amber [43,44]. They were probably replaced later in the Cenozoic by competing weevils occupying a similar arboreal ecological niche, the so-called “leaf” Adelognatha weevils, represented in Europe by the tribes Phyllobiini and Polydrusini. There are no reliable identified fossil Phyllobiini. Three species of Polydrusini are known from Baltic amber, but they are rare. We assume that Anypotactini were displaced in North America and Europe by ecological similar

forms from Tanymericini (e.g., *Pandeleiteius* Schoenherr, 1834), Scythropini (e.g., *Pachyrhinus* Schoenherr, 1823) and Polydrusini (*Polydrusus* Germar, 1817).

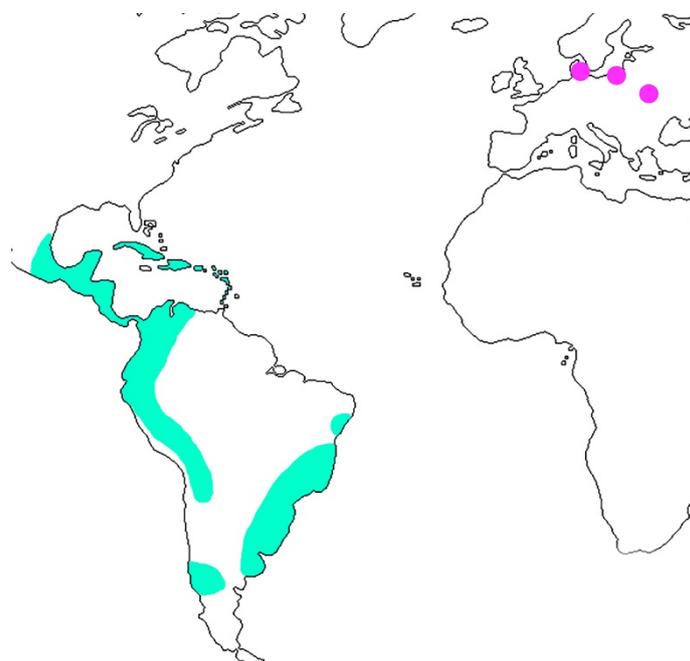


Figure 4. Distribution of the tribe Anypotactini: pink dots—fossil records; green area—modern distribution.

The genus *Nototactus* Kuschel, 1952 occurs in isolation from the main range of the tribe Anypotactini in relict warm temperate forests of their host Dombey's beech (*Nothofagus dombeyi*). *Nototactus* may be a modern ecological analogue of the late Eocene *Paonaupactus*, today inhabiting a relictual analogue of the late Eocene middle latitude climate, and it further diminished as competitors appeared. In this case, one would expect a significantly greater abundance and diversity of *Paonaupactus* in Baltic amber compared to Rovno amber, observed for example in Scleroderminae [45], or at least a much greater diversity of the Baltic *Paonaupactus* compared to Rovno amber, as in extant Chilean–Argentine Bethyridae, common in subtropical regions of Chile including the Valdivian forests [46,47]; however, there are three Rovno species of *Paonaupactus* and four Baltic species, and the five Rovno + Danish species are even more common than the Baltic ones, albeit from greatly differing sample sizes.

However, the supposed wide range of the host plants of Anypotactini (nonspecialized Entiminae) may have contributed to the dominance of *Paonaupactus* in the amber forests of Europe. Thus, the generally more thermophilic American tribe Eudiagogini (Figure 5) associated in the Nearctic with trees of the legume family (*Sesbania*, *Prosopis*) [48,49] is represented in Europe by one species. Extant species of *Eudiagogus* close to the oldest species of the genus from the early Eocene Green River feed on *Sesbania*. Eudiagogini is known from early Eocene Oise amber, late Eocene Florissant, and Miocene Dominican amber, but not late Eocene amber of Europe. It can be assumed that species of this tribe were associated with legumes in the Oise amber forest, in which the amber tree was supposedly close to *Hymenaea* [50], and possibly also in the Dominican amber forest (the tribe Eudiagogini is absent in the modern Dominican fauna). In the late Eocene forests of Europe, legumes are almost unknown: two species have been reported in Baltic amber [51], but they are absent in the Eocene floras of Polissya [52]. The paratropical forests that produced Oise amber may have provided favorable conditions for Eudiagogini. Interestingly, the oldest narrow pod with seeds parallel to the axis of the fruit characteristic of *Sesbania* and several other extant genera of legumes [53] are thought to have originated in the rich late Oligocene swamp and riparian Eger Wind Brickyard flora of Hungary.

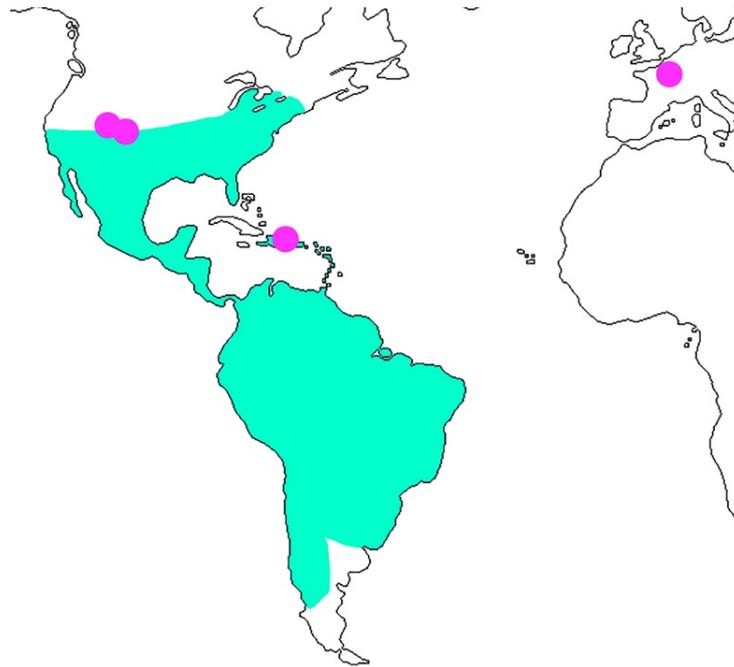


Figure 5. Distribution of the tribe Eudiagogini: pink dots—fossil records; green area—modern distribution.

5. Conclusions

The geological and geographic distribution of the Neotropical tribes Anypotactini and Eudiagogini in Europe might be explained by a combination of climate and the presence or absence of host plants and competitors. The extinction of European Anypotactini coincides with an increase in temperature seasonality of the climate in the middle latitudes with the transition to the Oligocene. Even the genus *Nototactus*, the most adapted of the genera of the tribe to a temperate climate, endemic to the Valdivian temperate forests [54], is found in the mountains on the border of Chile and Argentina, which has an average coldest monthly temperature of 2–3 °C and is not found south of there, while the range of its host *Nothophagus dombeyi* extends to regions with frosts down to −10 °C [55]. There is no evidence to suggest that *Paonaupactus* had a greater ability to endure cold winters.

Author Contributions: A.A.L. and E.E.P. designed the study, as well as prepared new species descriptions and plates. A.A.L. prepared the systematic placement of the new species. A.A.L., D.V.V. and E.E.P. drafted the manuscript and contributed to the writing and discussion. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The specimens were deposited in I. I. Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine (Kiev) and the Institute of Systematics and Ecology of Animals, Siberian Branch, Russian Academy of Sciences (Novosibirsk).

Acknowledgments: The authors thank U. Kotthoff (Germany: Hamburg) and K. Szczepaniak (Poland: Warsaw) for providing photographs of the types of *Paonaupactus* species stored in the Center of Natural History (Germany: Hamburg) and the Museum of the Earth (Poland: Warsaw), A.P. Vlaskin (SIZK) for cutting and polishing the sample, N. R. Khomich (Rovno, Ukraine) for the help with obtaining the specimen, S.A. Simutnik (SIZK) for the photographs, A.P. Rasnitsyn (Russia: Moscow) for discussion, S.B. Archibald (Canada: Vancouver) for improving the English in the manuscript, and E. Colonnelli (Italy: Rome) for help with the literature.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Alonso-Zarazaga, M.A.; Lyal, C.H.C. *A World Catalogue of Families and Genera Curculionoidea (Insecta: Coleoptera) (Excepting Scolytidae and Platypodidae)*; Entomopraxis: Barcelona, Spain, 1999; p. 315.
2. Legalov, A.A.; Nazarenko, V.Y.; Perkovsky, E.E. New weevils (Coleoptera: Curculionidae) from Rovno amber. *Paleontol. J.* **2019**, *53*, 1045–1059. [[CrossRef](#)]
3. Legalov, A.A. A review of the Curculionoidea (Coleoptera) from European Eocene ambers. *Geosciences* **2020**, *10*, 16. [[CrossRef](#)]
4. Legalov, A.A. Fossil history of Curculionoidea (Coleoptera) from the Paleogene. *Geosciences* **2020**, *10*, 358. [[CrossRef](#)]
5. Voss, E. Einige Rhynchophoren der Bernsteinfauna (Col.). *Mitt. Geol. Paläontol. Inst. Hambg.* **1953**, *22*, 119–140.
6. Voss, E. Einige Rüsselkäfer der Tertiärzeit aus Baltischen Bernstein (Coleoptera, Curculionidea). *Steenstrupia* **1972**, *2*, 167–181.
7. Zherikhin, V.V. On weevils (Insecta, Coleoptera) from the Baltic amber. *Tr. Paleontol. Inst. Akad. Nauk. SSSR* **1971**, *130*, 197–209.
8. Wanat, M.; Borovec, L. New genus of weevil (Coleoptera, Curculionidae) from Baltic amber. *Pol. Pismo Entomol.* **1986**, *56*, 243–247.
9. Yunakov, N.N.; Kirejtshuk, A.G. New genus and species of broad-nosed weevils from Baltic amber and notes on fossils of the subfamily Entiminae (Coleoptera, Curculionidae). *ZooKeys* **2011**, *160*, 73–96. [[CrossRef](#)]
10. Perkovsky, E.E.; Nel, A. A new Rovno amber termite genus (Isoptera, Rhinotermitidae) from Styr River basin. *Palaeont. Electron.* **2021**, *24*, a05. [[CrossRef](#)]
11. Matalin, A.V.; Perkovsky, E.E.; Vasilenko, D.V. First record of tiger beetles (Coleoptera, Cicindelidae) from Rovno amber with the description of a new genus and species. *Zootaxa* **2021**, *5016*, 243–256. [[CrossRef](#)]
12. Lawrence, J.F.; Beutel, R.G.; Leschen, R.A.B.; Slipinsky, S.A. Chapter 2. Glossary of Morphological Terms. In *Handbook of Zoology. Arthropoda: Insecta. Coleoptera, Beetles. Volume 2: Morphology and Systematics (Elateroidea, Bostrichiformia, Cucujiformia partim)*; Kristensen, N.P., Beutel, R.G., Eds.; Walter de Gruyter: Berlin, Germany; New York, NY, USA, 2010; pp. 9–20.
13. Bukejs, A.; Háva, J.; Alekseev, V.I. A new fossil species of *Attagenus* Latreille (Coleoptera: Dermestidae) in Rovno and Baltic ambers, with a brief review of known fossil beetles from the Rovno amber Lagerstätte. *Foss. Rec.* **2020**, *23*, 95–104. [[CrossRef](#)]
14. Bukejs, A.; Alekseev, V.I.; Kairišs, K. The first record of Cupedidae (Coleoptera: Archostemata) from Eocene Rovno amber: *Cupes groehni* Kirejtshuk, 2005 examined using X-ray microtomography. *Balt. J. Coleopterol.* **2021**, *21*, 111–116.
15. Lyubarsky, G.Y.; Perkovsky, E.E. New findings of Cryptophagidae (Coleoptera: Clavicornia) from Baltic amber in the unbiased collection of the Paleontological Institute of RAS. *Russ. Entomol. J.* **2021**, *30*, 282–287. [[CrossRef](#)]
16. Telnov, D.; Perkovsky, E.E.; Vasilenko, D.V.; Yamamoto, S. The first fossil Coleoptera record from the Volyn Region, Ukraine, with description of a new *Glesoconomorpha* (Coleoptera, Mycteridae) in syninclusion with Winterschmidtidae (Acari) and a key to species. *ZooKeys* **2021**, *1068*, 189–201. [[CrossRef](#)]
17. Tshernyshev, S.E.; Perkovsky, E.E. *Protomauroania mikhailovi*—A new species of malachite beetles (Coleoptera, Dasytidae) in Rovno amber. *Zootaxa* **2021**, *5006*, 189–194. [[CrossRef](#)]
18. Alekseev, V.I.; Bukejs, A. A new fossil genus of minute-clubbed beetles (Coleoptera: Cucujoidea: Monotomidae) from Paleogene amber of Europe. *Hist. Biol.* **2022**. [[CrossRef](#)]
19. Alekseev, V.I.; Bukejs, A. A new extinct species of *Zavaljus* Reitter (Coleoptera: Erotylidae) from Rovno amber: Boreal distribution range since the Eocene. *Hist. Biol.* **2022**. [[CrossRef](#)]
20. Bukejs, A.; Alekseev, V.I. Extant genus of flat bark beetle (Coleoptera: Silvanidae) with a present-day Australian-southern South American disjunction discovered in Eocene Rovno amber. *Zootaxa* **2022**, *5129*, 137–144. [[CrossRef](#)]
21. Kazantsev, S.V.; Perkovsky, E.E. Imprint of a *Helcophorus* Fairmaire, 1881: The first net-winged beetle (Coleoptera: Lycidae) from Rovno amber. *Zootaxa* **2022**, *5128*, 84–90. [[CrossRef](#)]
22. Kirichenko-Babko, M.; Perkovsky, E.E.; Vasilenko, D.V. A new genus and species of Lebiini (Coleoptera: Carabidae) from late Eocene Rovno amber. *Hist. Biol.* **2022**, *34*, 436–442. [[CrossRef](#)]
23. Kirichenko-Babko, M.; Perkovsky, E.E.; Vasilenko, D.V. †*Antephilorhizus zerovae* sp. nov. (Carabidae: Lebiini), the second ground beetle species from Rovno amber. *Hist. Biol.* **2022**. [[CrossRef](#)]
24. Legalov, A.A.; Nazarenko, V.Y.; Perkovsky, E.E. A new species of the genus *Glaesotropis* Gratshev and Zherikhin, 1995 (Coleoptera, Anthribidae) from Rovno amber. *Foss. Rec.* **2021**, *24*, 1–7. [[CrossRef](#)]
25. Legalov, A.A.; Nazarenko, V.Y.; Perkovsky, E.E. A new species of the genus *Dorytomus* Germar, 1817 (Coleoptera, Curculionidae) from Rovno amber. *Zootaxa* **2021**, *5006*, 95–100. [[CrossRef](#)] [[PubMed](#)]
26. Legalov, A.A.; Nazarenko, V.Y.; Vasilenko, D.V.; Perkovsky, E.E. *Ceutorhynchus* Germar (Coleoptera, Curculionidae) as proxy for Eocene Brassicaceae: First record of the genus from Rovno amber. *J. Paleontol.* **2022**, *96*, 379–386. [[CrossRef](#)]
27. Legalov, A.A.; Vasilenko, D.V.; Perkovsky, E.E. New proxy for Moraceae in Priabonian of Europe: First record of the genus *Demimaesa* Pascoe, 1870 (Coleoptera: Curculionidae) from Eocene Rovno amber. *Hist. Biol.* **2022**. [[CrossRef](#)]
28. Vitali, F.; Perkovsky, E.E. *Poliaenus europaeus* n. sp., the first cerambycid from Rovno amber (Coleoptera Cerambycidae). *Hist. Biol.* **2022**. [[CrossRef](#)]
29. Yamamoto, S.; Nazarenko, V.Y.; Vasilenko, D.V.; Perkovsky, E.E. First fossil species of ship-timber beetles (Coleoptera: Lymexyliidae) from Eocene Rovno amber (Ukraine). *Foss. Rec.* **2022**, *25*, 65–74. [[CrossRef](#)]
30. Perkovsky, E.E.; Odnosum, V.K.; Nazarenko, V.Y.; Vasilenko, D.V. First record of the genus *Cyrtanaspis* Emery (Insecta: Coleoptera: Scrautiidae) from Baltic amber. *Paleontol. J.* **2022**, *56*, 208–212. [[CrossRef](#)]

31. Perkovsky, E.E. Rovno amber caddisflies (Insecta, Trichoptera) from different localities, with information about three new sites. *Vestn. Zool.* **2017**, *51*, 15–22. [[CrossRef](#)]
32. Melnitsky, S.I.; Ivanov, V.D.; Perkovsky, E.E. A new species of *Plectrocnemia* (Trichoptera: Polycentropodidae) from Rovno amber. *Zootaxa* **2021**, *5006*, 106–109. [[CrossRef](#)]
33. Melnitsky, S.I.; Ivanov, V.D.; Perkovsky, E.E. A new species the fossil genus *Electrotrichia* (Insecta: Trichoptera: Hydroptilidae) from Rovno amber (Zhytomyr region, Olevsk amber locality). *Palaeontology* **2021**, *4*, 421–424. [[CrossRef](#)]
34. Melnitsky, S.I.; Ivanov, V.D.; Perkovsky, E.E. A new species of the genus *Holocentropus* (Trichoptera: Polycentropodidae) from Rovno amber. *Zoosystematica Ross.* **2021**, *30*, 298–302. [[CrossRef](#)]
35. Simutnik, S.A.; Perkovsky, E.E.; Khomych, M.R.; Vasilenko, D.V. Two new genera of Encyrtidae (Hymenoptera, Chalcidoidea) with reduced ovipositor sheaths. *J. Hymenopt. Res.* **2022**, *89*, 47–60. [[CrossRef](#)]
36. Simutnik, S.A.; Perkovsky, E.E.; Vasilenko, D.V. *Protaphycus shuvalikovi* Simutnik gen. et sp. n. (Chalcidoidea, Encyrtidae, Encyrtinae) from Rovno amber. *J. Hymenopt. Res.* **2022**, *91*, 1–9. [[CrossRef](#)]
37. Olmi, M.; Eggs, B.; Capradossi, L.; van de Kamp, T.; Perkovsky, E.E.; Guglielmino, A.; Vasilenko, D.V. A new species of *Bocchus* from upper Eocene Rovno amber (Hymenoptera: Dryinidae). *J. Hymenopt. Res.* **2022**, *92*, 257–272. [[CrossRef](#)]
38. Olmi, M.; Guglielmino, A.; Vasilenko, D.V.; Perkovsky, E.E. Discovery of the first apterous pincer wasp from amber, with description of a new tribe, genus and species of Apodryiniinae (Hymenoptera, Dryinidae). *Zootaxa* **2022**, *5162*, 54–66. [[CrossRef](#)]
39. Dlussky, G.M.; Rasnitsyn, A.P. Ants (Insecta: Vespida: Formicidae) in the Upper Eocene amber of Central and Eastern Europe. *Paleontol. J.* **2009**, *43*, 1024–1042. [[CrossRef](#)]
40. Perkovsky, E.E.; Rasnitsyn, A.P.; Vlaskin, A.P.; Rasnitsyn, S.P. Contribution to the study of the structure of amber forest communities based on analysis of syninclusions in the Rovno amber (late Eocene of Ukraine). *Paleontol. J.* **2012**, *46*, 293–301. [[CrossRef](#)]
41. Kosmowska-Ceranowicz, B. *The Tadeusz Giecwicz's Collection at the Museum of the Earth, Polish Academy of Sciences, Warsaw*; Oficyna Wydawnicza Sadyba: Warsaw, Poland, 2001; pp. 1–97.
42. Perkovsky, E.E. Tropical and Holarctic ants in Late Eocene ambers. *Vestn. Zool.* **2016**, *50*, 111–122. [[CrossRef](#)]
43. Legalov, A.A. New species of weevils (Coleoptera, Curculionidae) in Dominican amber. *Paleontol. J.* **2019**, *53*, 511–521. [[CrossRef](#)]
44. Poinar, G., Jr.; Legalov, A.A. Five new species from the subfamily Entiminae (Coleoptera: Curculionidae) in Dominican amber. *Palaeont. Electron.* **2017**, *20*, 1–13. [[CrossRef](#)]
45. Colombo, W.D.; Perkovsky, E.E.; Vasilenko, D.V. The first sclerodermine flat wasp (Hymenoptera: Bethylinidae) from the upper Eocene Rovno amber Ukraine. *Alcheringa* **2021**, *45*, 429–434. [[CrossRef](#)]
46. Ramos, M.S.; Perkovsky, E.E.; Rasnitsyn, A.P.; Azevedo, C.O. Revision of Bethylinae fossils (Hymenoptera: Bethylinidae) from Baltic, Rovno and Oise amber, with comments on the Tertiary fauna of the subfamily. *Neues Jahrb. Fur Geol. Palaontol. Abh.* **2014**, *271*, 203–228. [[CrossRef](#)]
47. Perkovsky, E.E.; Olmi, M.; Vasilenko, D.V.; Capradossi, L.; Guglielmino, A. First *Bocchus* Ashmead (Hymenoptera: Dryinidae) from Upper Eocene Rovno amber: *B. schmalhauseni* sp. nov. *Zootaxa* **2020**, *4819*, 544–556. [[CrossRef](#)] [[PubMed](#)]
48. Warner, R.E. The genus *Eudiagogus* (Coleoptera, Curculionidae, Leptopiinae), with two new species on the weed *Sesbania* (Leguminosae). *Proc. Entomol. Soc. Wash.* **1979**, *81*, 304–320.
49. Ward, R.; O'Brien, C.W.; O'Brien, L.B.; Foster, D.E.; Huddleston, E.W. Annotated checklist of New World insects associated with *Prosopis* (mesquite). *U.S. Dep. Agric. Tech. Bull.* **1977**, *1557*, 1–115.
50. Jossang, J.; Bel-Kassaoui, H.; Jossang, A.; Seuleiman, M.; Nel, A. Quesnoin, a novel pentacyclic *ent*-diterpene from 55 million years old Oise amber. *J. Org. Chem.* **2008**, *73*, 412–417. [[CrossRef](#)]
51. Czechtz, H. The flora of the Baltic amber and its age. *Prace Muz. Ziemi.* **1961**, *4*, 119–145.
52. Pimenova, N.V. *The Flora of the Tertiary Sandstones of the Western Bank-Region of the Dnieper in the Ukr*; Institute of Geological Science, Academy of Sciences of Ukrainian SSR: Kiev, Ukraine, 1937; pp. 1–135. (In Ukrainian)
53. Hably, L. Distribution of legumes in the Tertiary of Hungary. In *Advances in Legume Systematics: Part 4. The Fossil Record*; Herendeen, P.S., Dilcher, D.L., Eds.; The Royal Botanic Gardens: Kew, UK, 1992; pp. 169–187.
54. Morrone, J.J. The species of Entiminae (Coleoptera: Curculionidae) ranged in America south of the United States. *Anales Inst. Biol. Univ. Nac. Autón. México Zool.* **1999**, *70*, 99–168.
55. Alberdi, M.; Fernández, J.; Cristo, R.; Romero, M.; Rios, D. Lipid changes in cold hardened leaves of *Nothofagus dombeyi*. *Phytochemistry* **1991**, *29*, 2467–2471. [[CrossRef](#)]