The taxonomic structure of the fauna of ground beetles (Coleoptera, Carabidae) in the south of Eastern Siberia and Northern Mongolia

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Abstract. The taxonomic composition of the fauna has 577 species (608 subspecies) from 76 genera, representing 1% of the total fauna of the world and 5% of the Palearctic fauna. Most genera of ground beetles in the region have a predominantly Holarctic distribution, less often – Palearctic, tropical, or worldwide distribution. The fauna of the ground beetles of the region is based on the genera Amara, Bembidion, Pterostichus, Harpalus, and Carabus. The following genera are important for the fauna of ground beetles in the study region: Dyschirius, Agonum, Nebria, Cymindis, Dicheirotrichus, Poecilus, Trechus, Notiophilus, Elaphrus, Cicindela, Cylindera, Pogonus, Chlaenius, Pseudotaphoxenus.

1. Introduction
The fauna of the ground beetles of the south of Eastern Siberia and Northern Mongolia is characteristic of the Palearctic transition zone, which is common at the junction of the mutual influences of two natural regions – Siberian taiga and the arid steppes of Central Asia. The fauna of the ground beetles of the south of Eastern Siberia and Northern Mongolia is characterized by taxonomic diversity – 577 species (608 subspecies) from 76 genera, which account for up 1% of the total fauna of the world [1-3], 5% – of the Palearctic fauna [4, 5], and 24% – of the fauna of Russia [6].

2. Results
The genera structure of the fauna ground beetles is diverse and consisting of 76 genera (table 1). Most genera of ground beetles in the region have a predominantly Holarctic distribution (71%), less often – Palearctic (22%), tropical or worldwide (7%) distribution. The subgenera structure of the most predominant beetle genera is characterized by diversity and regional specificity.

The fauna of the ground beetles of the region is based on five genera – Amara, Bembidion, Pterostichus, Harpalus, and Carabus, which account for 320 species, or 55.3% of the species pool (SA) of the whole fauna (figure 1).

The genus Amara is most diverse in the fauna of ground beetles of the region. The dominance of members of this genus is characteristic of the forest-steppe zone. It is considered that the mixed-diet of these herbivorous beetles determines their wide distribution in most regions of North Asia. So, in the neighbouring regions as Tyva, Mongolia, Altai, this genus has 10–14% SA [4, 5, 7-9]. The subgenus structure of Amara is diverse (12 subgenera): Zezea Csiki, 1928; Amara Bonelli, 1810; Amarcocelia Motschulsky, 1862; Celia Zimmermann, 1832; Xenocelia Hieke, 2001; Reductocelia Lafer, 1989; Paracelia Bedel, 1899; Bradytus Stephens, 1828; Percosia Zimmermann, 1832; Amathitis Zimmermann, 1832; Curtonotus Stephens, 1828 and Ammoleirus Tschitschérine, 1899.
### Table 1. The genera structure of the fauna Carabidae of the south of Eastern Siberia and Northern Mongolia.

| No | Genus       | Number of species and subspecies (share of species abundance) | Distribution (areas) | No | Genus       | Number of species and subspecies (share of species abundance) | Distribution (areas) |
|----|-------------|---------------------------------------------------------------|----------------------|----|-------------|---------------------------------------------------------------|----------------------|
| 1  | *Cylindera* | 7 (1.2 %)                                                     | P, N                 | 39 | *Sericoda*  | 1 (0.2 %)                                                     | P, N                 |
| 2  | *Cephalota* | 1 (0.2 %)                                                     | P                    | 40 | *Agonum*    | 21 (3.6 %)                                                    | P, N                 |
| 3  | *Calomera*  | 1(2) (0.2 %)                                                  | P                    | 41 | *Limodromus*| 2 (0.3 %)                                                     | P                    |
| 4  | *Cicindela* | 8(10) (1.4 %)                                                 | P, N, A              | 42 | *Platyneus* | 1 (0.2 %)                                                     | P, N                 |
| 5  | *Pelophila* | 1 (0.2 %)                                                     | P                    | 43 | *Anchemenus*| 1 (0.2 %)                                                     | P, N                 |
| 6  | *Leistus*   | 3 (0.5 %)                                                     | P, N                 | 44 | *Olisthopus*| 1 (0.2 %)                                                     | P, N                 |
| 7  | *Nebria*    | 18 (3.1 %)                                                    | P, N                 | 45 | *Synuchus*  | 2 (0.3 %)                                                     | P, N                 |
| 8  | *Notiophilus*| 9 (1.6 %)                                                     | P, N                 | 46 | *Pristosia* | 1 (0.2 %)                                                     | EA, IM               |
| 9  | *Calosoma*  | 4 (0.7 %)                                                     | P, N                 | 47 | *Amara*     | 89(90) (15.4 %)                                               | P, N                 |
| 10 | *Carabus*   | 36(51) (6.2 %)                                                | P, N                 | 48 | *Anisodactylus*| 3 (0.5 %)                                                     | P, N                 |
| 11 | *Diacheila* | 2 (0.3 %)                                                     | P, N                 | 49 | *Bradyceillus*| 4 (0.7 %)                                                     | P, N                 |
| 12 | *Bletterisa*| 3(4) (0.5 %)                                                  | P, N                 | 50 | *Dicheirotrichus*| 12 (2.1 %)                                                    | P, N                 |
| 13 | *Elaphrus*  | 9 (1.6 %)                                                     | P, N                 | 51 | *Stenolophus*| 1 (0.2 %)                                                     | P, N                 |
| 14 | *Loricera*  | 1 (0.2 %)                                                     | P, N                 | 52 | *Harpalobrachys*| 1 (0.2 %)                                                     | P, N                 |
| 15 | *Clivina*   | 1 (0.2 %)                                                     | P, N                 | 53 | *Harpalus*  | 56(58) (9.7 %)                                                | P, N                 |
| 16 | *Dyschirius*| 24(25) (4.1 %)                                                | P, N                 | 54 | *Neophygas* | 1 (0.2 %)                                                     | P                    |
| 17 | *Miscoderia*| 1 (0.2 %)                                                     | P, N                 | 55 | *Microderes*| 2 (0.3 %)                                                     | P                    |
| 18 | *Eotrechodes*| 1 (0.2 %)                                                     | P                    | 56 | *Othonus*   | 4 (0.7 %)                                                     | P, N                 |
| 19 | *Masuza*    | 1 (0.2 %)                                                     | P                    | 57 | *Perigona*  | 1 (0.2 %)                                                     | P, N                 |
| 20 | *Trechus*   | 10 (1.7 %)                                                    | P, N                 | 58 | *Panagaetus*| 1 (0.2 %)                                                     | P, N                 |
| 21 | *Tachys*    | 1 (0.2 %)                                                     | P, N                 | 59 | *Callistus* | 1 (0.2 %)                                                     | P                    |
| 22 | *Paratacys* | 1 (0.2 %)                                                     | Neo, IM              | 60 | *Chlaenius* | 6 (1 %)                                                       | P, N, A              |
| 23 | *Tachyta*   | 1 (0.2 %)                                                     | P, N                 | 61 | *Oodes*     | 1 (0.2 %)                                                     | P, N                 |
| 24 | *Asaphidion*| 3 (0.5 %)                                                     | P, N                 | 62 | *Licinus*   | 1 (0.2 %)                                                     | P, N                 |
| 25 | *Bembidion* | 83(84) (14.3 %)                                               | P, N                 | 63 | *Badister* | 3 (0.5 %)                                                     | P, N                 |
| 26 | *Pogonous*  | 7 (1.2 %)                                                     | P, N                 | 64 | *Masoreus*  | 1 (0.2 %)                                                     | P                    |
| 27 | *Pogonistes*| 1 (0.2 %)                                                     | P, N                 | 65 | *Corisya*   | 1 (0.2 %)                                                     | P                    |
| 28 | *Patrobos*  | 3 (0.5 %)                                                     | P, N                 | 66 | *Lionedya*  | 1 (0.2 %)                                                     | P                    |
| 29 | *Platildius*| 1 (0.2 %)                                                     | P, N                 | 67 | *Lebia*     | 2 (0.3 %)                                                     | P, N                 |
| 30 | *Diplous*   | 2 (0.3 %)                                                     | P, N                 | 68 | *Demetrias* | 1 (0.2 %)                                                     | P                    |
| 31 | *Pocialis*  | 11 (1.9 %)                                                    | P, N                 | 69 | *Dromius*   | 4 (0.7 %)                                                     | P, N                 |
| 32 | *Pterostichus*| 56(59) (9.7 %)                                                | P, N                 | 70 | *Paradromius*| 2 (0.3 %)                                                     | P                    |
| 33 | *Sterecerus*| 1 (0.2 %)                                                     | P, N                 | 71 | *Philorrhizus*| 1 (0.2 %)                                                     | P, N                 |
| 34 | *Calathus*  | 3 (0.5 %)                                                     | P, N                 | 72 | *Microlestes*| 3 (0.5 %)                                                     | P, IA, E, A, N       |
| 35 | *Pseudotaphoxenus*| 5(7) (0.9 %)                                          | P                    | 73 | *Syntomus*  | 3 (0.5 %)                                                     | P, N                 |
| 36 | *Taphoxenus*| 1 (0.2 %)                                                     | P                    | 74 | *Apristus*  | 2 (0.3 %)                                                     | P, N                 |
| 37 | *Reflexisolodus*| 3 (0.5 %)                                              | P                    | 75 | *Cymindis*  | 15(16) (2.6 %)                                                | P, N                 |
| 38 | *Laestogenus*| 1 (0.2 %)                                                     | P, N                 | 76 | *Mastax*    | 1 (0.2 %)                                                     | P                    |

P – Paleartic; N – Neartic; A – Afrotropic; E – Eastern; Neo – Neotropic; IM – Indo-Malay; IA - Indo-Australian; EA - East Asian
At the same time, most species are represented by subgenera *Amara* s. str. (30 species), *Curtonotus* (19 species), *Bradytus* (11 species), *Celia* (9 species), *Amathitis* (6 species) and *Xenocelia* (5 species). For the fauna of the ground beetles of the region, a large number of species of the subgenera *Curtonotus* and *Bradytus* can be considered specific [10]. The subgenus *Curtonotus* in the region’s fauna is characterized by an unusually high species abundance (19 species, 3.3% SA). These are herbivorous beetles typical of steppe and forest-steppe landscapes. The share of the subgenus *Curtonotus* is smallest in Kuznetsk Alatau and Gornaya Shoria – 0.5% SA [11], the largest – in Onon and South Dauria and Southeast Altai – 2.9-3% SA [12, 13]. For the fauna of the ground beetles of the region, a large number of species of the subgenus *Bradytus* can be considered specific to Baikal Siberia [10]. In the regions of Southern Siberia, the subgenus *Bradytus* is poor. So, on Kuznetsk Alatau and in Tyva, only three species are known [9, 11], in Southeast Altai – only two [13], in the Amur Region, Khabarovsk and Primorsky Territories – five-six species each [14].

![Figure 1](image-url)  
**Figure 1.** The genera structure of the fauna Carabidae in the study region.

The genus *Bembidion* is widely represented on the study territory, carrion and predators, most of which live near water along flat and mountain lakes, rivers and streams from mountain steppes to highlands. This genus in the region is represented by 25 subgenera: *Bracteon* Bedel, 1879; *Odontium* LeConte, 1848; *Hydrium* LeConte, 1847; *Chlorodium* Motschulsky, 1864; *Metallina* Motschulsky, 1846; *Testedium* Motschulsky, 1864; *Notaphus* Dejean, 1821; *Eupetedromus* Netolitzky, 1911; *Philochthus* Stephens, 1828; *Emphanes* Motschulsky, 1850; *Nepericompus* Netolitzky, 1935; *Trepanes* Motschulsky, 1864; *Trepanedoris* Netolitzky, 1918; *Semicampa* Netolitzky, 1910; *Diplocampa* Bedel, 1896; *Bembidion* Latreille, 1802; *Melomalus* Casey 1918; *Plataphus* Motschulsky, 1864; *Hirmoplataphus* Netolitzky, 1943; *Blepharoplataphus* Netolitzky, 1920; *Trichoplataphus* Netolitzky, 1914; *Peryphus* Dejean, 1821; *Asioperyphus* Vysoký, 1986; *Terminophanes* Müller–Motzfeld, 1998; *Ocydromus* Clairville, 1806. Among them, a variety of subgenera *Plataphus* (12), *Peryphus* (12), *Asioperyphus* (6), *Bracteon* (6), *Emphanes* (5), *Semicampa* (5) are characteristic. In the fauna of ground beetles of Southern Siberia, the genus *Bembidion* is about the same – 14-20% SA [7, 9, 11, 15], and in Southeast Altai – even 25% SA [13].
The genus *Pterostichus* is diverse. Predators are mainly associated with forests. So, on Kuznetsk Alatau and in Gornaya Shoria, *Pterostichus* is 12% SA [11], and in Tyva – only 8% SA [9]. The subgenus structure of the genus *Pterostichus* in the study region is characterized by increased diversity (14 subgenera): *Platysma* Bonelli, 1810; *Metallophilus* Chaudoir, 1838; *Argutor* Dejean, 1821; *Badistrius* Motschulsky, 1866; *Pledarus* Motschulsky, 1866; *Adelosia* Stephens, 1835; *Pseudomarseus* Chaudoir, 1838; *Phonias* Gozis, 1886; *Cryobius* Chaudoir, 1838; *Eosisteropus* Tschitschérine, 1902; *Lenapeterus* O. Berlov, 1996; *Bothriopiterus* Chaudoir, 1835; *Morphnosoma* Lutshnik, 1915; *Petrophilus* Chaudoir, 1838. The specificity of the fauna of the beetles of the region is the diversity of two subgenera – *Cryobius* (16 species) and *Petrophilus* (9 species), characteristic of the mountain taiga regions of Southern Siberia.

The genus *Harpalus* is also abundantly represented in the region from the subgenus *Pseudoophonus* and *Harpalus* s. str., the latter accounts for most species. These are mainly herbivorous beetles, most often granivorous. A characteristic feature of the genus *Harpalus* is the connection with open, relatively dry biotopes [16]. Therefore, in regions with a predominance of forests, the share of *Harpalus* species is insignificant. For example, in Kuznetsk Alatau, *Harpalus* is only 6% SA [11], and in arid and semiarid Tyva and Mongolia, it increases to 14% SA [4, 5, 9]. The subgenus structure of the genus *Harpalus* consists of two subgenera *Pseudoophonus* Motschulsky, 1844 and *Harpalus* Latreille, 1802, while the latter accounts for a significant part of the species.

All species of the genus *Carabus* are predators, found in mountain forests, less in the tundra, as well as in fields, meadows, swamps, and the steppe. In some regions of Southern Siberia, the share of *Carabus* ranges from 4 to 12%, for example, in Southeast Altai – 4% SA [11], in Kuznetsk Alatau and Gornaya Shoria – 5% SA [11], in Central Sayan Highlands – 8% SA [17], in the East Tyva Highlands – 12% SA [8]. The subgenus structure of *Carabus* in the region is numerous (18 subgenera): *Eucarabus* Géhin, 1876, *Tachypus* Weber, 1801, *Carabus* Linné, 1758, *Morphocarabus* Géhin, 1876, *Trachycarabus* Géhin, 1876, *Homeocarabus* Reitter, 1896, *Hemicarabus* Géhin, 1876, *Aulonocarabus* Reitter, 1896, *Diocarabus* Reitter, 1896, *Oreocarabus* Géhin, 1876, *Tomocarabus* Reitter, 1896, *Scambocarabus* Reitter, 1896, *Pachystus* Motschulsky, 1866, *Megodontus* Solier, 1848, *Pachycranius* Solier, 1848, *Acoptolabrus* A. Morawitz, 1886, *Coptolabrus* Solier, 1848, *Eupachys* Chaudoir, 1857. Taxonomic diversity is noted in the subgenera *Morphocarabus* (7 species) and *Diocarabus* (6), which are characteristic of the fauna of the beetles of the region. The subgenus *Morphocarabus* is distinguished by numerous subspecies in the mountains of Cisbaikalia and Transbaikalia.

Also important for the characterization of the fauna of ground beetles in the study region are 14 genera (162 species): *Dyschirius*, *Agonum*, *Nebria*, *Cymindis*, *Dicheirotrichus*, *Poeclis*, *Trechus*, *Notiophillus*, *Elaphrus*, *Cicindela*, *Cylindera*, *Pogonus*, *Chlaenius*, *Pseudotaphoxenus*. The remaining 57 genera account for 95 species (16% SA), which are presented in one–four species.

The genus *Dyschirius* is characterized by a high species abundance in the fauna of the region. Most species are confined to the shores of fresh or saline reservoirs. This genus is least represented on Kuznetsk Alatau and in Gornaya Shoria falls – 0.5% SA [11], then its share increases in Southeast Altai – 4.3% SA [13], and in Onon and South Dauria, it jumps sharply to 8.6% SA [12]. In the subgenus structure, four subgenera *Dyschirius* Bonelli, 1810, *Eudysschirius* Fedorenko, 1996, *Dyschiriodes* Jeannel, 1941 and *Chiridysus* Fedorenko, 1996 were identified, while most species belong to the nominative subgenus (17 species).

The genus *Agonum* is abundantly represented in the study region. These beetles are predators. Most species live in humid places in meadows, swamps or near waterbodies and are characteristic of humid areas. This genus is least represented in Southeast Altai – 3% SA [13], a little more in Onon and South Dauria – 3.6% SA [12], and in Kuznetsk Alatau and in Gornaya Shoria, its share increases to 6% SA [11]. The genus *Agonum* is represented by three subgenera *Agonum* s. str. Bonelli, 1810, *Olisares* Motschulsky, 1864 and *Europhilus* Chaudoir, 1859. The taxonomic diversity of *Agonum* is rich in the subgenera *Olisares* and *Europhilus* (8 species each).
The genus *Nebria* is diverse in the region. Predators are confined to the banks of reservoirs, especially mid-mountain and high-mountain rivers and streams. This genus is not characteristic of Onon and Southern Dauria – 0.7% SA [12], but in the mountainous regions of Southern Siberia, its share increases to 4% SA on Kuznetsk Alatau and in Gornaya Shoria [11], up to 7% SA – in Southeast Altai [13]. In the subgeneric structure of *Nebria*, 6 subgenera were identified: *Paranebria* Jeannel, 1937, *Boreonebria* Jeannel, 1937, *Pseudonebriola* Ledoux & Roux, 1989, *Reductonebria* Shilenkov, 1975, *Catonebria* Shilenkov, 1975, *Eunebria* Semenov & Znojko, 1928. Among them, *Boreonebria* (7 species) and *Catonebria* (five species) prevail.

The genus *Cymindis* is represented by predators, is characteristic of steppe and desert-steppe landscapes. Representatives of the genus are least represented in Kuznetsk Alatau and in Gornaya Shoria – 0.5% SA [11], most of all in Onon and South Dauria and Southeast Altai – 2.1–2.7% SA [12, 13]. The subgenus structure of the genus *Cymindis* is diverse (10 subgenera) – *Baicalotarus* Emetz, 1974; *Chaetotator* Reitter, 1903; *Cymindis* Latreille, 1806; *Falocymindis* Sundukov, 2011; *Iscariotes* Reiche, 1855; *Orientoberus* Sundukov, 2011; *Tarsostinus* Motschulsky, 1864; *Tarulus* Bedel, 1906; *Paracymindis* Jedlička, 1968; *Arrhostus* Motschulsky, 1864. In each subgenus, only one–three species were identified.

The genus *Dicheirotrichus* is abundantly represented in the region. Herbivorous beetles live on salt marshes and moist meadows from steppes to highlands. The proportion of the genus is small in Kuznetsk Alatau and Gornaya Shoria, Onon and South Dauria (0.5–0.7% SA) [11, 12], and in Southeast Altai, his share increases to 2.7% SA [13]. The subgenus structure of *Dicheirotrichus* includes three subgenera: *Dicheirotrichus* Jacquelain du Val, 1857; *Oreoxenus* Tschitschérine, 1899; *Trichocellus* Ganglbauer, 1891. At the same time, most species are represented by the subgenus *Trichocellus* (8 species).

The genus *Poecilus* in the region is represented by predators, common in the steppe and forest-steppe zone. The share of the genus *Poecilus* in Southeast Altai is 1.6% SA [13], and in Kuznetsk Alatau and Gornaya Shoria, it almost doubles – 3% SA [11]. Species belong to two subgenera – *Poecilus* Bonelli, 1810 (7 species) and *Derus* Motschulsky, 1850 (4 species), while the latter subgenus is quite specific for the south of the region.

The genus *Trechus* is distinguished in the fauna of the region by a high species abundance. Predators live in the litter of mountain forests and high mountain kobresian (Cyperaceae) meadows. Species of the subgenus *Trechus* in Siberia are mountain endemic; many of them have a very local distribution – only on one mountain range or even one mountain. Almost all Siberian *Trechus* are common in the Altai-Sayan mountain system, but within the region, the species distribution is unevenly distributed, except the widespread European-Siberian *T. rubens*. For example, up to five sympatric species of *Trechus* s.str. occur in West and Northeast Altai, and in Southeast Altai, they are absent [13]. In South Buryatia, five endemic species of the subgenus *Trechus* s.str. are known, only two species have occurred as sympatric among them [10]. Beetles belong to two subgenera – *Epaphius* Leach, 1819 (2 species) and *Trechus* Clairville, 1806 (4 species).

The genus *Cicindela* in the region is represented by predators, run fast and fly. They live in the steppe and forest-steppe zones in dry meadows, in steppes, on salt marshes, sandy spits along rivers, and sands of pine forests. The share of this genus in Southeast Altai is 1.6% SA [13], in Onon and South Dauria – 2.1% SA [12], and in Kuznetsk Alatau and in Gornaya Shoria it increases to 2.5% SA [11].

The genus *Nothiophilus* is also represented by predators with daytime activity, hunt for Collombola. They live in a forest litter among fallen foliage or in the bark of rotten wood. The proportion of the genus varies from 1.1% SA in Southeast Altai [13] to 2.5% SA in Kuznetsk Alatau and Gornaya Shoria [11]. This genus is not registered in Onon and Southern Dauria [12].

The genus *Elaphrus* is represented by predators with daytime activity inhabiting the banks of reservoirs, swamps, and swampy places. The share of this genus is almost the same in the regions of Southern Siberia: in Onon and Southern Dauria – 1.4% SA [12], in Kuznetsk Alatau and in Gornaya Shoria – 1.5% SA [11], and in Southeast Altai – 1.6% SA [13]. The subgenus structure of the genus consists of 4 subgenera: *Aretelaphrus* Semenov, 1926; *Neoelaphrus* Hatch, 1951; *Elaphrus* Fabricius, 1775; *Elaphrotatus* Semenov, 1895.
The genus *Pogonus* is represented by predators, most species are indicators of salt soils. The genus *Pogonus* is absent in Kuznetsk Alatau and Gornaya Shoria [11], in Southeast Altai, its share is 1.1% SA [13], and in Onon and South Dauria, its share increases to 3.6% SA [12]. The genus contains two subgenera *Pogonoidius* Carret, 1903 and *Pogonus* Nicolai, 1822, while most species belong to the nominative subgenus.

The genus *Cylindera* Westwood, 1831 is represented by predators who live in steppe landscapes. This genus is absent in Kuznetsk Alatau and Gornaya Shoria [11], and in Southeast Altai and Onon and South Dauria, their share is insignificant – 0.5–0.7% SA [12, 13].

The genus *Chlaenius* is represented by predators living along the shores of standing or slowly flowing reservoirs. Representatives of this genus are not recorded in Southeast Altai [13], but its share is quite high in Onon and South Dauria, Kuznetsk Alatau, and Gornaya Shoria – 2–2.1% SA [11, 12]. The subgenus structure consists of four subgenera: *Chlaenites* Motschulsky, 1860; *Chlaeniellus* Reitter, 1908; *Naelichus* Lutshnik, 1933; *Agostenus* Motschulsky, 1850.

The genus *Pseudotaphoxenus* is represented by predators inhabiting meadow-steppe and steppe areas, lead a twilight lifestyle, hide in rodent burrows during the day. Representatives of this genus are registered in the steppe landscapes of Southeast Altai [13], Buryatia [10], Onon and South Dauria [12], and Northern Mongolia [4, 5]. The proportion of this genus ranges from 0.5 to 1% SA. The diversity of this genus is the largest in the arid conditions of Northern Mongolia.

3. Conclusion

In general, the fauna of ground beetles in the south of Eastern Siberia and Northern Mongolia is characteristic of the ecotone zone between the taiga and the steppe. These features are reflected in the structure of fauna ground beetles. More than half of the species abundance of the fauna of the beetles of the region falls on the genera *Amara*, *Bembidion*, *Pterostichus*, *Harpalus*, and *Carabus*.

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