

Chalcidoid wasps (Hymenoptera: Chalcidoidea: Eulophidae, Eupelmidae, Eurytomidae, Megastigmidae, Ormyridae, Pteromalidae and Torymidae) from Sarnena Sredna Gora Mts

MIROSLAV ANTOV^{1*}, IVAYLO TODOROV², PETER BOYADZHIEV¹, ANELIA STOJANOVA¹, ELIZA KOTEVA¹

¹Department of Zoology, Faculty of Biology, University of Plovdiv "Paisii Hilendarski", 24 Tsar Assen Street, 4000 Plovdiv, Bulgaria, *miroslavantov@uni-plovdiv.bg; boyadz@uni-plovdiv.bg; stanelia@uni-plovdiv.bg; pestcorrect.ek@gmail.com

²Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd., 1000 Sofia, Bulgaria, i.toddorov@abv.bg

Abstract. The published data on Eulophidae, Eupelmidae, Eurytomidae, Megastigmidae, Ormyridae, Pteromalidae and Torymidae families from territory of Sarnena Sredna Gora Mts were summarized. New records are also presented. A total of 15 eulophids (of them nine are new records to the region and one species – *Neotrichoporoides biogradensis* Graham, 1987 is new to the Bulgarian fauna), 11 eupelmids (six are new records to the region), seven eurytomids (five are new records to the region), two megastigmids (new records to the region), three ormyrids (one is new record to the region), nine pteromalids (of them eight are new to the region and one species – *Miscogaster hortensis* Walker, 1833 is new to the Bulgarian fauna) and four torymids (new records to the region) are reported.

Key words: Hymenoptera, Chalcidoidea, new records, Sarnena Sredna Gora Mts, Bulgaria.

Introduction

Chalcidoidea Latreille, 1817 is an extremely diverse superfamily of small wasps including more than 26 000 described species worldwide (Ghahari *et al.* 2021), although the actual total number of the species is estimated at over 500 000 (Munro *et al.* 2011; Heraty *et al.* 2013). Currently, 23 families are recognized in the superfamily (Ghahari *et al.* 2021) whose members are mostly parasitoids attacking immature stages of a wide spectrum of insect hosts as well as mites, ticks, spiders, pseudoscorpiones and even gall-forming Nematoda (Austin *et al.* 1998; Gibson *et al.* 1999).

Eulophidae Westwood, 1829 is the most diverse family of Chalcidoidea containing 5998 extant and three fossil species placed in 323 genera (Yefremova *et al.* 2021). Members of this family develop as ecto- or endoparasitoids on a wide range of insect hosts, specifically those belonging to Coleoptera, Diptera, Hymenoptera and Lepidoptera, though many other hosts are known (Schauff *et al.* 1997; Gadallah *et al.* 2015).

Eupelmidae Walker, 1833 is a relatively small family within Chalcidoidea with 1049 extant species classified in 43 extant genera (Gibson & Ghahari 2021). The family has a cosmopolitan distribution (Fusu *et al.* 2015; Kissayi & Benhalima 2017), but its highest species diversity is in tropical regions (Kalina 1984; Gibson 1995; Kissayi & Benhalima 2017). Eupelmids are ectoparasitoids of the immature stages (larvae or pupae) of many insects (beetles, flies, moths, wasps) concealed or protected in plant tissues (flower heads, seeds, stems, galls) or are endoparasitoids or predators of insect or spider eggs (Gibson

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1997). Polyphagy and hyperparasitism on a wide range of insects are typical for many eupelmid species (Gibson 1995).

Eurytomidae Walker, 1832 is a worldwide distributed family with the highest variety of species in tropical regions (Stojanova *et al.* 2012). The family includes 1600 extant and three fossil species belonging to 73 genera (Zerova *et al.* 2021a). Most of eurytomids are primary or secondary parasitoids of a broad spectrum of insect hosts in the orders Coleoptera, Diptera, Hymenoptera and Lepidoptera, while others are phytophagous (gall-formers in grass stems and seed feeders in various plant families) (Çam 2012; Stojanova *et al.* 2012).

Megastigmidae Thomson, 1876 is a worldwide distributed family (Böhmová *et al.* 2022) comprising 214 described species classified in 12 genera (Zerova *et al.* 2021d). Megastigmidae are parasitoids of various gall-inducing Diptera (mainly Cecidomyiidae) and of gall-making Hymenoptera (mainly Cynipidae and Chalcidoidea) or are phytophagous (Böhmová *et al.* 2022).

Ormyridae Förster, 1856 is one of the smallest families of Chalcidoidea with 147 recognized species referred to three genera (Zerova *et al.* 2021b) and distributed on all continents (Stojanova 2005; Lotfalizadeh *et al.* 2012), but most numerous in the tropics (Zerova & Seryogina 2006; Zerova *et al.* 2021b). Ormyrids are ectoparasitoids of gall-inducing insects, belonging to Hymenoptera (Cynipidae) and Diptera (Agromizidae, Cecidomyiidae and Tephritidae) (Askew 1994; Zerova & Seryogina 2006; Lotfalizadeh *et al.* 2012).

Pteromalidae Dalman, 1820 is the third largest family of Chalcidoidea, currently containing 4257 extant and 26 fossil species classified in 648 genera and 34 subfamilies (Gibson *et al.* 2021). Species are mostly primary or secondary, solitary or gregarious parasitoids of the preimaginal stages (mainly larvae and pupae) of a fairly broad spectrum of insect hosts, but most often attacked are Coleoptera, Diptera and Lepidoptera (Bouček & Heydon 1997; Gibson *et al.* 2021).

Torymidae Walker, 1833 is one of the mid-sized families of Chalcidoidea represented in the world fauna with 1028 extant species arranged in 61 genera (Zerova *et al.* 2021c). Most torymids are primary parasitoids or hyperparasitoids of a wide variety of insect hosts belonging to several orders, but phytophagous species also occur (Grissell 1995; Stojanova 2010; Zerova *et al.* 2021c).

The chalcidoid wasp fauna of the seventh mentioned families on the territory of Sarnena Sredna Gora Mts has not been a subject of special investigation. Only five species of Eulophidae (Staykov 1954; Tsalbukov 1964; Nikolova 1972; Tsankov *et al.* 1996; Mirchev *et al.* 2021), five species of Eupelmidae (Keremidchiev & Gantshev 1973; Tsankov *et al.* 1996; Antov & Stojanova 2020; Georgiev *et al.* 2021; Mirchev *et al.* 2021), two species of Eurytomidae (Stojanova 1997) and two species of Ormyridae (Stojanova 2005) have been recorded from this area till now.

The aim of this article is to summarize the published data on Eulophidae, Eupelmidae, Eurytomidae, Megastigmidae, Ormyridae, Pteromalidae and Torymidae families from territory of Sarnena Sredna Gora Mts and to present new faunistic records.

Material and Methods

The material for this study was collected mainly by the first author in 2018 in two localities of Sarnena Sredna Gora Mts (Starozagorski bani Vill., 42°27'27.2" N 25°28'36.8" E, 411 m and Zmeyovo Vill., 42°30'02.7" N 25°37'32.8" E, 490 m) by sweeping in dry meadows and pastures dominated by *Chrysopogon gryllus* (L.) Trin. and *Dichanthium ischaemum* (L.) Roberty (Poaceae). Some species were reared at laboratory conditions from Cynipidae (Hymenoptera) galls on *Quercus* spp. and *Rosa* spp. Imagoes were fixed in ethyl alcohol, dried using isopropanol or HMDS and mounted on card points. Identification of the

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species was based on the keys by Bouček (1959), Graham (1969, 1987, 1991, 1992), Trjapitzin & Kostjukov (1978), Dzhankov (1980), Kalina (1981, 1988), Grissell (1995), Zerova (1995), Graham & Gijswijt (1998), Zerova & Seryogina (1998, 1999), Gibson (2010, 2011), Rizzo & Mitroiu (2010), Gibson & Fusu (2016), Hansson (2016), Fusu (2017) and Janšta *et al.* (2018). The list of established species includes the following data: the valid taxon name; published data for Sarnena Sredna Gora Mts; examined material with locations, date of collecting, number and sex of the specimens; the name of the host (in case of rearing) as well as the name of the collector (if different from the first author). New species records for Sarnena Sredna Gora Mts are marked with an asterisk (*) in the faunistic list and new species for Bulgaria with double asterisk (**). The material is preserved in the authors' collections at the University of Plovdiv and Institute of Biodiversity and Ecosystems Research, Bulgarian Academy of Sciences.

Results and Discussion

A total of 15 eulophids, 11 eupelmids, seven eurytomids, two megastigmids, three ormyrids, nine pteromalids and four tolymids were established on the territory of Sarnena Sredna Gora Mts.

Faunistic list:

EULOPHIDAE Westwood, 1829

ENTEDONINAE Förster, 1856

Neochrysocharis Kurdjumov, 1912

****Neochrysocharis albiscapus*** Erdős, 1954

Material examined: Starozagorski bani Vill., 25.VIII.2018, 2 ♀♀.

ENTINAE Hedqvist, 1974

Euderus Haliday, 1844

****Euderus brevicornis*** Bouček, 1963

Material examined: Starozagorski bani Vill., 25.VIII.2018, 1 ♂.

EULOPHINAE Westwood, 1829

Diaulinopsis Crawford, 1912

****Diaulinopsis arenaria*** (Erdős, 1951)

Material examined: Starozagorski bani Vill., 25.VIII.2018, 7 ♀♀, 4 ♂♂.

Sympiesis Förster, 1856

****Sympiesis flavopicta*** Bouček, 1959

Material examined: Starozagorski bani Vill., 25.VIII.2018, 1 ♀, 1 ♂.

TETRASTICHINAE Förster, 1856

Aprostocetus Westwood, 1833

****Aprostocetus crino*** (Walker, 1838)

Material examined: Starozagorski bani Vill., 25.VIII.2018, 2 ♀♀.

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Baryscapus Förster, 1856

****Baryscapus impeditus*** (Nees, 1834)

Material examined: Starozagorski bani Vill., 25.VIII.2018, 3 ♀♀.

Baryscapus servadeii (Domenichini, 1965)

Baryscapus servadeii: Tsankov *et al.* (1996); Mirchev *et al.* (2021)

Baryscapus transversalis Graham, 1991

Baryscapus transversalis: Tsankov *et al.* (1996)

Neotrichoporoides Girault, 1913

*****Neotrichoporoides biogradensis*** Graham, 1987

Material examined: Starozagorski bani Vill., 25.VIII.2018, 1 ♀.

Oomyzus Rondani, 1870

****Oomyzus incertus*** (Ratzeburg, 1844)

Material examined: Starozagorski bani Vill., 25.VIII.2018, 1 ♂.

****Oomyzus scaposus*** (Thomson, 1878)

Material examined: Starozagorski bani Vill., 25.VIII.2018, 1 ♀.

Sigmophora Rondani, 1867

****Sigmophora brevicornis*** (Panzer, 1804)

Material examined: Starozagorski bani Vill., 25.VIII.2018, 1 ♀.

Tetrastichus Haliday, 1844

Tetrastichus agrili Crawford, 1915

Tetrastichus agrili: Staykov (1954)

Tetrastichus atrocoeruleus (Nees, 1834)

Tetrastichus atrocoeruleus: Tsalbukov (1964)

Tetrastichus hylotomarum (Bouche, 1834)

Tetrastichus hylotomarum: Nikolova (1972)

EUPELMIDAE Walker, 1833

CALOSOTINAE Bouček, 1958

Calosota Curtis, 1836

****Calosota grylli*** Erdős, 1955

Material examined: Zmeyovo Vill., 24.VIII.2018, 1 ♀; Starozagorski bani Vill., 25.VIII.2018, 1 ♀.

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EUPELMINAE Walker, 1833 **Anastatus** Motschulsky, 1859

Anastatus bifasciatus (Geoffroy, 1785)

Anastatus bifasciatus: Tsankov *et al.* (1996); Georgiev *et al.* (2021); Mirchev *et al.* (2021)

***Anastatus giraudi** (Ruschka, 1921)

Material examined: Macropterous form. Zmeyovo Vill., 24.VIII.2018, 1 ♀. Micropterous form. Starozagorski bani Vill., 25.VIII.2018, 1 ♀.

Anastatus japonicus Ashmead, 1904

Anastatus disparis: Keremidchiev & Gantshev (1973)

Eupelmus Dalman, 1820

***Eupelmus (Episolindelia) australiensis** (Girault, 1913)

Material examined: Zmeyovo Vill., 24.VIII.2018, 4 ♀♀; Starozagorski bani Vill., 25.VIII.2018, 1 ♀.

***Eupelmus (Episolindelia) linearis** Förster, 1860

Material examined: Zmeyovo Vill., 24.VIII.2018, 3 ♀♀.

Eupelmus (Eupelmus) azureus Ratzeburg, 1844

Eupelmus azureus: Antov & Stojanova (2020)

Material examined: N of Lyulyak Vill., 42°31'25.5" N 25°39'26.4" E, 517 m, 15.VI.2018, 1 ♀ (D. Georgiev).

***Eupelmus (Eupelmus) microzonus** Förster, 1860

Material examined: Zmeyovo Vill., 24.VIII.2018, 6 ♀♀.

Eupelmus (Eupelmus) urozonus Dalman, 1820

Eupelmus urozonus: Antov & Stojanova (2020)

***Eupelmus (Macroneura) barai** Fusu, 2017

Material examined: Starozagorski bani Vill., 25.VIII.2018, 5 ♀♀.

Eupelmus (Macroneura) vesicularis (Retzius, 1783)

Macroneura vesicularis: Tsankov *et al.* (1996)

EURYTOMIDAE Walker, 1832

EURYTOMINAE Walker, 1832

Bruchophagus Ashmead, 1888

***Bruchophagus mutabilis** Nikolskaya, 1952

Material examined: Sredno Gradishte Vill., 02.VIII.1967, 1 ♀ (A. Germanov).

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Eurytoma Illiger, 1807

****Eurytoma amygdali*** Enderlein, 1907

Material examined: Varben Vill., 13.XI.2007, 1 ♀, ex. dried fruit of *Amygdalus communis* L. (Rosaceae) (A. Stojanova).

****Eurytoma brunniventris*** Ratzeburg, 1852

Material examined: Moruley Hut, 26.I.1997, 2 ♂♂, 1 ♀, ex. Cynipidae galls on *Quercus* sp. (A. Stojanova); Varben Vill., 17.XI.1998, 16 ♂♂, 27 ♀♀, ex. *Andricus quercuscalicis* (Burgsdorff, 1783) (Cynipidae) galls on *Quercus* sp. (A. Stojanova); 15.IV.1999, 41 ♂♂, 35 ♀♀, ex. *A. quercuscalicis* galls on *Quercus* sp. (A. Stojanova); Starozagorski bani, 13.X.1999, 2 ♀♀, ex. *Andricus subterranea* (Giraud, 1859) (Cynipidae) galls on *Quercus* sp. (A. Stojanova); 13.X.1999, 2 ♂♂, ex. *Andricus coriarius* (Hartig, 1843) (Cynipidae) galls on *Quercus* sp. (A. Stojanova); 31.X.1999, 1 ♀, ex. *A. subterranea* galls on *Quercus* sp. (A. Stojanova); 25.III.2000, 100 ♂♂, 200 ♀♀, ex. *A. quercuscalicis* galls on *Quercus* sp. (A. Stojanova); 25.III.2000, 1 ♀, ex. *Andricus caputmedusae* (Hartig, 1843) (Cynipidae) galls on *Quercus* sp. (A. Stojanova); 01.VIII.2000, 1 ♀, ex. Cynipidae galls on *Quercus* sp. (A. Stojanova).

Eurytoma pistaciae Rondani, 1877

Eurytoma pistaciae: Stojanova (1997)

Material examined: Varben Vill., 18.VIII.1998, 1 ♂, ex. Cynipidae galls on *Quercus* (A. Stojanova); 13.IV.1999, 2 ♀♀, ex. *A. quercuscalicis* galls on *Quercus* sp. (A. Stojanova).

****Eurytoma rosae*** Nees, 1834

Material examined: Moruley Hut, 26.I.1997, 2 ♂♂, 5 ♀♀, ex. *Diplolepis rosae* (Linnaeus, 1758) (Cynipidae) galls on *Rosa* sp. (A. Stojanova); Varben Vill., 13.XI.2007, 2 ♂♂, 1 ♀, ex. *D. rosae* galls on *Rosa* sp. (A. Stojanova).

Sycophila Walker, 1871

Sycophila biguttata (Swederus, 1795)

Sycophila biguttata: Stojanova (1997)

Material examined: Varben Vill., 18.VIII.1998, 4 ♂♂, 2 ♀♀, ex. *A. quercuscalicis* galls on *Quercus* (A. Stojanova); 04.IX.1998, 2 ♀♀, ex. Cynipidae galls on *Quercus* sp. (A. Stojanova); 17.XI.1998, 2 ♀♀, ex. *A. quercuscalicis* galls on *Quercus* sp. (A. Stojanova); 15.IV.1999, 2 ♂♂, 1 ♀, ex. *A. quercuscalicis* galls on *Quercus* sp. (A. Stojanova); 25.III.2000, 1 ♀, ex. *A. caputmedusae* galls on *Quercus* sp. (A. Stojanova); 25.III.2000, 1 ♂, 6 ♀♀, ex. *A. quercuscalicis* galls on *Quercus* sp. (A. Stojanova).

****Sycophila variegata*** (Curtis, 1831)

Material examined: Varben Vill., 25.III.2000, 1 ♂, 4 ♀♀, ex. *A. quercuscalicis* galls on *Quercus* sp. (A. Stojanova).

MEGASTIGMIDAE Thomson, 1876

Bootanomyia Girault, 1915

****Bootanomyia dorsalis*** (Fabricius, 1798)

Material examined: Moruley Hut, 26.I.1997, 1 ♀, ex. Cynipidae galls on *Quercus* sp. (A. Stojanova); Varben Vill., 13.XI.2007, 1 ♂, ex. *A. quercuscalicis* galls on *Quercus* sp. (A. Stojanova).

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**Bootanomyia stigmatizans* (Fabricius, 1798)

Material examined: Varben Vill., 15.IV.1999, 3 ♂♂, ex. *A. quercuscalicis* galls on *Quercus* sp. (A. Stojanova); 25.III.2000, 1 ♀, ex. *A. caputmedusae* galls on *Quercus* sp. (A. Stojanova); 25.III.2000, 1 ♂, 1 ♀, ex. *Cynips quercusfolii* Linnaeus, 1758 (Cynipidae) galls on *Quercus* sp. (A. Stojanova); Starozagorski bani Vill., 13.XII.2001, 1 ♂, 1 ♀, ex. Cynipidae galls on *Quercus* sp. (V. Parvanov).

ORMYRIDAE Förster, 1856

Ormyrus Westwood, 1832

**Ormyrus destefanii* Mayr, 1904

Material examined: near Moruley Peak, VI.2018, 1 ♀ (D. Georgiev).

Ormyrus nitidulus (Fabricius, 1804)

Ormyrus nitidulus: Stojanova (2005)

Ormyrus pomaceus (Geoffroy, 1785)

Ormyrus pomaceus: Stojanova (2005)

PTEROMALIDAE Dalman, 1820

MISCOGASTRINAE Walker, 1833

Miscogaster Walker, 1833

***Miscogaster hortensis* Walker, 1833

Material examined: N of Zmeyovo Vill., 42°30'11.8" N 25°36'01.5" E, 445 m, 24.VI.2018, 1 ♀, collected in grassland near *Medicago sativa* L. and *Foeniculum vulgare* Mill. plantations (D. Georgiev).

PTEROMALINAE Dalman, 1820

Catolaccus Thomson, 1878

**Catolaccus crassiceps* (Masi, 1911)

Material examined: Zmeyovo Vill., 24.VIII.2018, 3 ♀♀.

Homoporus Thomson, 1878

**Homoporus apharetus* (Walker, 1839)

Material examined: Zmeyovo Vill., 24.VIII.2018, 1 ♀.

**Homoporus fulviventris* (Walker, 1835)

Material examined: Zmeyovo Vill., 24.VIII.2018, 1 ♀.

Ischyroptyx Delucchi, 1956

**Ischyroptyx ligusticus* (Masi, 1922)

Material examined: Starozagorski bani Vill., 25.VIII.2018, 1 ♀.

Mesopolobus Westwood, 1833

**Mesopolobus teliformis* (Walker, 1834)

Material examined: Zmeyovo Vill., 24.VIII.2018, 3 ♀♀, 1 ♂.

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Norbanus Walker, 1843

***Norbanus meridionalis** (Masi, 1922)

Material examined: Zmeyovo Vill., 24.VIII.2018, 1 ♀.

Psilocera Walker, 1833

***Psilocera crassispina** (Thomson, 1878)

Material examined: Starozagorski bani Vill., 25.VIII.2018, 1 ♂.

Pteromalus Swederus, 1795

***Pteromalus elevatus** (Walker, 1834)

Material examined: W of Yagoda Vill., 42°32'20.8" N 25°33'34.7" E, 290 m, 02.VII.2018, 1 ♂ (D. Georgiev).

TORYMIDAE Walker, 1833

GLYPHOMERINAE Janšta, Cruaud, Delvare, Genson, Heraty, Krizkova & Rasplus, 2018

Glyphomerus Förster, 1856

***Glyphomerus stigma** (Fabricius, 1793)

Material examined: Moruley Hut, 26.I.1997, 2 ♂♂, 2 ♀♀, ex. *D. rosae* galls on *Rosa* sp. (A. Stojanova); Varben Vill., 13.XI.2007, 2 ♂♂, ex. *D. rosae* gall on *Rosa* sp. (A. Stojanova).

MONODONTOMERINAE Ashmead, 1899

Monodontomerus Westwood, 1833

***Monodontomerus aereus** Walker, 1834

Material examined: Moruley Hut, 26.I.1997, 2 ♀♀, ex. *A. caputmedusae* galls on *Quercus* sp. (A. Stojanova).

TORYMINAE Walker, 1833

Torymus Dalman, 1820

***Torymus bedeguaris** (Linnaeus, 1758)

Material examined: Moruley Hut, 26.I.1997, 2 ♂♂, 3 ♀♀, ex. *D. rosae* galls on *Rosa* sp. (A. Stojanova).

***Torymus cyaneus** Walker, 1847

Material examined: Varben Vill., 13.XI.2007, 2 ♀♀, ex. *C. quercusfolii* galls on *Quercus* sp. (A. Stojanova).

A total of 15 eulophids were established on the territory of Sarnena Sredna Gora Mts that belong to ten genera: *Aprostocetus* – one species; *Baryscapus* – three species; *Diaulinopsis* – one species; *Euderus* – one species; *Neochrysocharis* – one species; *Neotrichoporoides* – one species; *Oomyzus* – two species; *Sigmophora* – one species; *Sympiesis* – one species and *Tetrastichus* – three species. Of them, nine are new records to the region and one species – *N. biogradensis* is new to the Bulgarian fauna. Eleven eupelmids from three genera: *Anastatus* with three species, *Calosota* with one species and

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Eupelmus with seven species are reported for the fauna of Sarnena Sredna Gora Mts. Six of them are new records to the region. Seven eurytomids from three genera: *Bruchophagus* with one species, *Eurytoma* with four species and *Sycophila* with two species were established. Five of them are new records to the region. Two megastigmids belonging to the genus *Bootanomyia* and three ormyrids belonging to the genus *Ormyrus* are reported. Three of them are new records for the region. Totally, nine pteromalids belonging to eight genera: *Catolaccus* with one species, *Homoporus* with two species, *Ischyroptyx* with one species, *Mesopolobus* with one species, *Miscogaster* with one species, *Norbanus* with one species, *Psilocera* with one species and *Pteromalus* with one species were established. Eight of them are new records for the fauna of Sarnena Sredna Gora Mts and one species – *M. hortensis* is new to the Bulgarian fauna. A total of four torymids from three genera: *Glyphomerus* – one species, *Monodontomerus* – one species and *Torymus* – two species are reported. All of them are new records for the region.

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