

Dynamics of the abundance of cuckoo wasps (Hymenoptera, Chrysididae) in the conditions of the altitudinal-belt heterogeneity of the North Caucasus

Nikolay Vinokurov*

Tembotov Institute of Ecology of Mountain Territories of Russian Academy of Science, 360051 Nalchik, Russia

Abstract. The work provides data on the dynamics of the abundance of 205 taxa from 19 genera: *Cleptes*, *Colpopyga*, *Elampus*, *Omalus*, *Philoctetes*, *Pseudomalus*, *Hedychridium*, *Hedychrum*, *Holopyga*, *Chrysidea*, *Chrysis*, *Euchroeus*, *Chrysura*, *Pseudochrysis*, *Spinolia*, *Spinolia*, including species rare and new for the fauna of the North Caucasus and Russia. By the nature of the population dynamics, five groups of cuckoo wasps were identified: spring – represented by 7 species from 4 genera; spring-summer – 76 species from 10 genera; summer – 113 species from 16 genera; summer-autumn – 4 species from 2 genera and spring-summer-autumn – 5 species from 3 genera. According to the duration of flight, eurychronous species of cuckoo wasps were identified, which are found throughout the season from spring to autumn; mesochronous – the years of which affect the end of May and summer months and stenochronous – confined to a short period of time. Eurychronic accounted for 2.4%, mesochronous 24.9%, stenochronic 72.7%. The number of generations of cuckoo wasps is related to the dynamics of the number of the host. In the mountains, the peaks of activity shift towards the middle of summer, most species have one peak of activity; due to the frequent changes in weather conditions in the mountains, the phenological characteristics of the cuckoo wasps and their hosts do not coincide in terms with the lowland populations and the periods of activity can be extended in time. Phenological characteristics of rare and new species for the fauna of the North Caucasus and Russia are presented for the first time. The data obtained expand the understanding of the biodiversity and dynamics of the abundance of cuckoo wasps in the North Caucasus and can be used for environmental protection measures and rational nature management in the south of Russia.

1 Introduction

Cuckoo wasps (Chrysididae: Cleptinae, Chrysidinae) is a widespread group of hymenoptera; in the fauna of Russia there are 340 species and 13 subspecies from 23 genera [1]. Being entomophages, in biocenoses they can influence the number of their hosts – wild bees (Megachilidae) and some other wasps: Crabronidae; Vespidae (Eumeninae).

Information on the seasonal dynamics of flight and the phenological characteristics of the cuckoo wasps are not numerous and relate to the flat part of the Northwestern Black Sea region [2], the Interfluvium of the Prut and Dniester [3] and Central Ciscaucasia [4]. For the first time, data on the dynamics of the abundance of wasp wasps in mountainous and foothill landscapes North Caucasus are presented. It is known that mountain landscapes have their own characteristics, where the parameters of the biota naturally change in all three dimensions of space, depending on the biological effect.

Taking into account the current state of the of the interaction of mountains and adjacent plains, factors of zoning in the plain and zonality in the mountains [5], taking into account the current state of the recreational load on the natural landscapes of the North Caucasus,

and the expansion of monitoring studies, knowledge of the patterns of the dynamics of the abundance of components of biocenoses is important.

In this regard, new data on the dynamics of the population of cuckoo wasps, taking into account the altitudinal-belt structure of the landscapes of the North Caucasus, are relevant and can be used to solve practical and scientific issues.

The aim of this work was to study the dynamics of the abundance of cuckoo wasps (Hymenoptera, Chrysididae) in the conditions of the altitudinal-belt heterogeneity of the North Caucasus.

2 Materials and methods

The collection of material was carried out in 1987 – 2020: in Ciscaucasia – Stavropol Territory, the main part of which is from the territory of the specially protected ecological-resort region of the Caucasian Mineral Waters; in the Western Caucasus – Krasnodar Territory, Utrish Nature Reserve, Caucasian Nature Reserve, Sochi National Park, in the Republic of Adygea, the vicinity of Maikop, Lagonaki Plateau; in the Central Caucasus – the Kabardino-Balkarian high-mountain reserve, the Elbrus

* Corresponding author: niko-vinokurov@yandex.ru

National Park; in Karachay-Cherkessia – Teberdinsky reserve and its Arkhyz section; in Dagestan – the Dagestan nature reserve with its sites: Sarykum dunes, Kizlyar Bay and «Samurskiy Les» [6-19], also used materials from the collection of the Zoological Institute of the Russian Academy of Sciences (St. Petersburg).

For the collection of insects, the methods generally accepted in entomology were used: mowing with an entomological net, individual trapping and colored traps by Mörike [20-22]. The taxonomic position of species is given according to the system that has developed to date [23-29]. Zoogeographic regionalization of the Caucasus is given according to Sokolov, Tembotov [30].

3 Results and Discussion

Shiny wasps live in the nesting places of their owners, where they actively manifest themselves as entomophages, regulating their numbers. The paper provides data on the dynamics of the abundance of 205 taxa from 19 genera, including rare, poorly studied, and new species for the fauna of the North Caucasus.

The sustainable development of biocenoses is influenced by many factors, of which hydrothermal conditions and the presence of ecological niches for their inhabitants can be decisive. As shown by the research results, 205 taxa from 19 genera were recorded in the dynamics of the abundance of cuckoo wasps in the Northern Caucasus: *Cleptes*, *Colpopyga*, *Elampus*, *Omalus*, *Philoctetes*, *Pseudomalus*, *Hedychridium*, *Hedychrum*, *Holopyga*, *Chrysidea*, *Chrysis*, *Euchroeus*, *Chrysura Spintarina*, *Stilbum*, *Trichrysis*, *Parnopes*.

According to seasonal activity, 5 phenological groups were identified: spring, spring-summer, summer, spring-summer-autumn and summer-autumn (tabl., fig. 1-3).

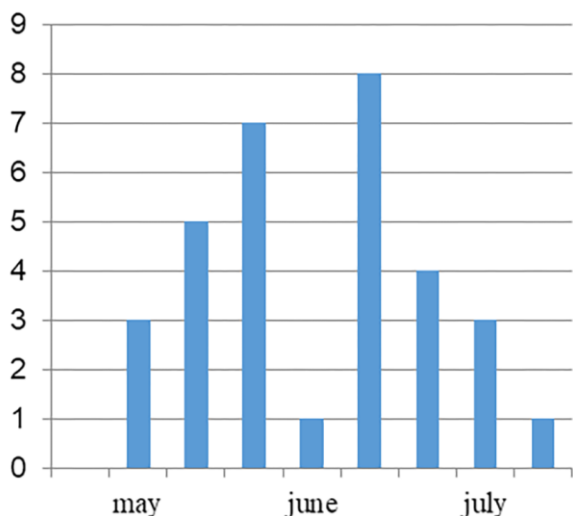


Fig. 1. The abundance of *C. gracillima gracillima*

The spring group is small and includes 7 taxa from 4 genera: *Elampus spina* (Lepelletier, 1806); *Holopyga generosa generosa* (Förster, 1853); *Chrysis corusca* Valkeila, 1971; *C. frivaldzkyi sparsepunctata* du

Buysson, 1891; *C. rufitarsis rufitarsis* Brullé, 1833; *Chrysura erigone* (Mocsáry, 1889); *Ch. trimaculata* (Förster, 1853). This group includes species recorded in arid conditions, where air and soil temperatures correspond to summer values already at the end of May. We fully admit that in other variants of the zonation of landscapes on the territory of the North Caucasus, some species from this group may also occur in early summer. For example, the cuckoo wasp *C. frivaldzkyi sparsepunctata* was recorded for the first time in the North Caucasus, it is rare, and additional information on the dynamics of numbers can clarify its phenological characteristics. *Chr. trimaculata* has not been previously registered in the North Caucasus.

Table 1. Types of seasonal activity of cuckoo wasps

Activity type	IV	V	VI	VII	VIII	IX	Generations	species
Spring	*	*					1	7
Spring-summer		*	*	*	*		1-2	76
Summer			*	*	*		2	113
Spring-autumn	*	*	*	*	*	*	2-3	5
Summer-autumn			*	*	*	*	1	1

Spring-summer group (May – first half of summer) is represented by 76 species from 10 genera: *Cleptes ignitus* (Fabricius, 1787); *Cl. insidiosus* du Buysson, 1891; *Cl. semiauratus* (Linnaeus, 1761; *Omalus aeneus* (Fabricius, 1787); *Pseudomalus auratus auratus* (Linnaeus, 1758); *Ps. auratus viridiventris* (Mocsáry, 1890); *Ps. violaceus* (Scopoli, 1763); *Hedychridium ardens ardens* Coquebert, 1801; *H. elegantulum* du Buysson, 1887; *H. erschovi* (Radoszkowski, 1877); *H. roseum roseum* (Rossi, 1790); *H. rossicum* Gussakovskij, 1948; *Hedychrum aureicolle aureicolle* Mocsáry, 1889; *He. gerstaeckeri gerstaeckeri* Chevriernm, 1869; *He. gerstaeckeri plicatus* Kilimnik, 1993; *He. longicolle* Abeille de Perrin, 1877; *He. niemelai* Linsenmaier, 1969; *He. nobile* (Scopoli, 1763); *He. tobiasi* Kilimnik, 1993; *Holopyga amoenula amoenula* Dahlbom, 1845; *Ho. amoenula occidentata* Linsenmaier, 1959; *Ho. ignicollis* Dahlbom, 1854; *Ho. chrysonota chrysonota* (Förster, 1853); *Ho. fervida fervida* (Fabricius, 1781); *Ho. inflammata inflammata* (Förster, 1853); *Ho. jurinei* Chevrier, 1862; *Ho. medvedevi* Semenov, 1967; *Ho. metallica* (Dahlbom, 1854); *Ho. mlokosiewitzi* (Radoszkowski, 1877); *Ho. pavlovskii* Semenov & Nikol'skaya, 1954; *Ho. punctatissima punctatissima* Dahlbom, 1854; *Ho. vigora* Linsenmaier, 1959; *Chrysidea disclusa disclusa* (Linsenmaier, 1959); *Ch. pumila* (Klug, 1845); *Chrysis analis analis* Spinola, 1807; *C. angustifrons angustifrons* Abeille de Perrin, 1878; *C. angustula angustula*

Schenck, 1856; *C. bergi* Semenov, 1967; *C. calimorpha calimorpha* Mocsáry, 1882; *C. caucasicola* Balthasar, 1953; *C. cerastes cerastes* Abeille de Perrin, 1877; *C. cingulicornis cingulicornis* Förster, 1853; *C. comta* Förster, 1853; *C. csikiana* (Mocsáry, 1912); *C. cylindrica* Eversmann, 1858; *C. dafnis syriensis* Linsenmaier, 1959; *C. diacantha diacantha* Mocsáry, 1889; *C. equestris* Dahlbom, 1854; *C. fasciata* Oliver, 1791; *C. gracillima gracillima* (Förster, 1853); *C. graelsii graelsii* Guérin-Méneville, 1842; *C. grohmanni krkiana* Linsenmaier, 1959; *C. inaequalis* Dahlbom, 1845; *C. leachii* Schuckard, 1837; *C. longula sublongula* Linsenmaier, 1951; *C. mediadentata* Linsenmaier, 1951; *C. mesasiatica* Semenov, 1912; *C. mutabilis mutabilis* du Buysson, 1887; *C. neobule* Semenov, 1954; *C. placida* Mocsáry, 1879; *C. pulchella pulchella* Spinola, 1807; *C. schousboei* Dahlbom, 1854; *C. sexdentata sexdentata* Christ, 1791; *C. taczanovskii* Radoszkowski, 1877; *C. tenella* Mocsáry, 1889; *C. zonata zonata* Dahlbom, 1854; *Chrysura cuprea cuprea* (Rossi, 1790); *Chr. dichroa dichroa* (Dahlbom, 1854); *Chr. ignifrons* (Brullé, 1883); *Chr. laevigata laevigata* (Abeille de Perrin, 1879); *Chr. nikolaji* Rosa, 2017; *Chr. pseudodichroa* (Linsenmaier, 1959); *Chr. radians* (Harris, 1776); *Pseudochrysis humboldti humboldti* (Dahlbom, 1854); *Ps. neglecta* (Schuckard, 1837); *Ps. uniformis* (Dahlbom, 1854).

One or two peaks of activity can be observed in the population dynamics. The species *C. gracillima gracillima* has 2 peaks (Fig. 1). The increase in numbers is observed at the end of May and reaches a peak at the beginning and at the end of June and gradually decreases by the middle of summer. The species *C. comta* has 2 peaks of activity, the maximum falls on the middle of July (Fig. 2).

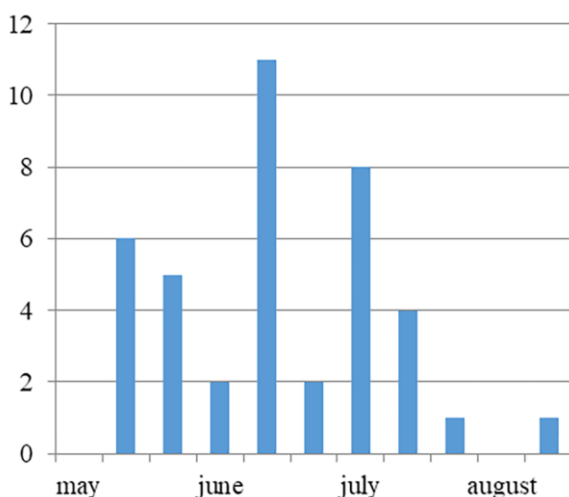


Fig. 2. The abundance of *C. comta* Tr.

This group includes taxa that were recorded in semi-desert conditions on the territory of the Dagestan reserve (the Sarykum dunes section), only there the species *C. tenella* was recorded. Species: *C. neobule* and *C. mesasiatica* in the steppe zone of the Dagestan variant of zonation were recorded in May, and in the Elbrus one –

in early June; *Chrysura cuprea cuprea* in the Western Caucasus (Kuban version of zonation) and in Dagestan (Dagestan version of zonation) occurs in May, and in Elbrus – in the first ten days of June.

Summer group of 113 species from 16 genera: *Cleptes nitidulus* (Fabricius, 1793); *Cl. radoszkowskii* Mocsáry, 1889; *Cl. splendidus* (Fabricius, 1794); *Cl. striatipleuris* Rosa et al., 2015; *Colpopyga flavipes flavipes* (Eversmann, 1858); *Elampus constrictus* (Förster, 1853); *El. eversmanni* (Mocsáry, 1889); *El. foveatus* (Mocsáry, 1914); *El. panzeri* (Fabricius, 1804); *El. pyrosomus pyrosomus* (Förster, 1853); *Omalus biaccinctus* (du Buysson, 1892); *O. hohlbecki* (Semenov, 1932); *O. stella* (Semenov, 1932); *Philoctetes bidentulus* (Lepelletier, 1806); *Ph. bogdanovi bogdanovi* (Radoszkowski, 1877); *Ph. conifer* (Semenov, 1932); *Ph. kuznetsovi* (Semenov, 1932); *Ph. sareptanus* (Mocsáry, 1889); *Pseudomalus bergi* (Semenov, 1932); *Ps. pusillus pusillus* (Fabricius, 1804); *Ps. triangulifer* (Abeille de Perrin, 1877); *Hedychridium aheneum aheneum* (Dahlbom, 1854); *H. caputaureum* G. Trautmann & W. Trautmann, 1919; *H. caucasicum* Trautmann, 1926; *H. chloropygum chloropygum* du Buysson, 1888; *H. coriaceum coriaceum* (Dahlbom, 1854); *H. cupreum* Dahlbom, 1845; *H. femoratum femoratum* Dahlbom, 1854; *H. jucundum* (Mocsáry, 1889); *H. lucidiventre* Semenov, 1967; *H. palestinense* Balthasar, 1946; *H. purpurascens* (Dahlbom, 1854); *H. satunini* Semenov, 196; *H. sculpturatum sculpturatum* (Abeille de Perrin, 1877); *H. scutellare* (Tournier, 1878); *H. trossulus* (Semenov, 1954); *H. uvarovi* Semenov, 1967; *Hedychrum alexii* Semenov, 1967; *He. caucasicum* Mocsáry, 1889; *He. chalybaeum* Dahlbom, 1854; *He. cholodkovskii* Semenov, 1967; *He. kozhantshikovi* Semenov, 1967; *He. rutilans rutilans* Dahlbom, 1854; *He. virens* Dahlbom, 1854; *Chrysis aello* Semenov & Nikol'skaya, 1954; *C. aestiva* Dahlbom, 1854; *C. bicolor* Lepelletier, 1806; *C. bilobata* Balthasar, 1953; *C. caspiensis* Linsenmaier, 1959; *C. chrysoprasina* Förster, 1853; *C. chryso stigma* Mocsáry, 1889; *C. circe* Mocsáry, 1889; *C. comparata* Lepelletier, 1806; *C. decora* Mocsáry, 1887; *C. distincta distincta* Mocsáry, 1887; *C. distincta thalhameri* Mocsáry, 1889; *C. erivanensis* Radoszkowski, 1880; *C. frankenbergeri* Balthasar, 1953; *C. frivaldzkyi frivaldzkyi* Mocsáry, 1882; *C. fulgida* Linnaeus, 1761; *C. galloisi* du Buysson, 1908; *C. germari germari* Wesmael, 1839; *C. glasunovi* Semenov, 1967; *C. grumorum* Semenov, 1892; *C. ignita ignita* (Linnaeus, 1758); *C. illigeri* Wesmael, 1839; du Buysson, 1895; *C. immaculata* du Buysson, 1898; *C. impressa* Schenck, 1856; *C. indigotea* Dufour & Perris, 1840; *C. insperata insperata* Chevrier, 1870; *C. iris* Christ, 1791; *C. lanceolata* Linsenmaier, 1959; *C. leptomandibularis* Niehuis, 2000; *C. longula longula* Abeille de Perrin, 1879; *C. lyda* Rosa, 2017; *C. maderi* Linsenmaier, 1959; *C. marginata marginata* Mocsáry, 1889; *C. mediata mediata* Linsenmaier, 1951; *C. obtusidens obtusidens* Dufour & Perris, 1840; *C. phryne* Abeille de Perrin, 1878; *C. poetica* Semenov, 1954; *C. pseudobrevitarsis* Linsenmaier, 1951; *C. ragusae* De Stefani, 1888; *C. ruddii ruddii* Schuckard,

1837; *C. rutiliventris rutiliventris* Abeille de Perrin, 1879; *C. sculpturata* Mocsáry, 1912; *C. scutellaris* Fabricius, 1794; *C. solida* Haupt, 1957; *C. sooni* Rosa, 2017; *C. soror* Dahlbom, 1854; *C. splendidula splendidula* Rossi, 1790; *C. subcoriacea* Linsenmaier, 1959; *C. subsinuata fallax* Mocsáry, 1882; *C. succincta* Linnaeus, 1767; *C. tragica* Semenov, 1967; *C. valesiana valesiana* Frey-Gessner, 1887; *C. valida* Mocsáry, 1912; *C. vicana* Vinokurov, 2010; *C. vinokurovi* Rosa, 2017; *C. viridula* Linnaeus, 1761; *C. zetterstedti* Dahlbom, 1845; *Euchroeus limbatus limbatus* Dahlbom, 1854; *Eu. purpuratus purpuratus* (Fabricius, 1787); *Chrysura filiformis* (Mocsáry, 1889); *Ch. lydiae lydiae* (Mocsáry, 1889); *Ch. purpureifrons* (Abeille de Perrin, 1878); *Pseudochrysis aureicollis* (Abeille de Perrin, 1879); *Spinolia chalcitis* (Mocsáry, 1890); *Sp. dournovii* (Radoszkowski, 1866); *Spintarina vagans* (Radoszkowski, 1877); *Stilbum calens* (Fabricius, 1781); *St. cyanurum cyanurum* (Förster, 1771); *Parnopes grandior grandior* (Pallas, 1771). The taxa *C. ruddii ruddii* and *C. viridula* are common in the mountains and rarely descend into the lower altitudinal belts. The species *Spintarina vagans* was first recorded for the fauna of Russia; it lives in the mountains from 1000 m to 1950 m above sea level; *Stilbum calens* – occurs everywhere in July and early August, in the mountains rises to the upper border of the forest. *C. chrysoprasina* – known from the foothills of the Central Caucasus for the North Caucasus, the species was recorded for the first time.

Spring-summer-autumn group of 5 species from 3 genera: *Hedychridium zelleri* (Dahlbom, 1845); *Chrysis comparata* Lepeletier, 1806; *C. rutilans rutilans* Olivier, 1791; *C. schencki* Linsenmaier, 1968; *Trichrysis cyanea* (Linnaeus, 1876). This group includes species both flat - *Hedychridium zelleri*, and those that rise to subalpine meadows – *Trichrysis cyanea*, in which 2-3 generations were recorded throughout the season. The abundance of the representative of this group, *Tr. cyanea*, remains at a high level throughout the season, but 3 peaks of activity can be distinguished (Fig. 3).

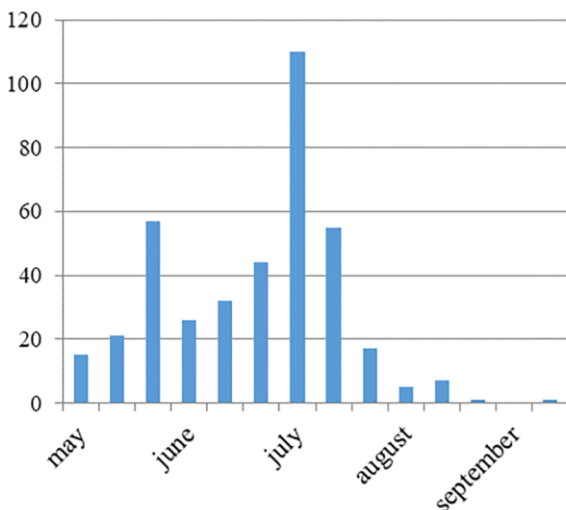


Fig. 3. The abundance of *Tr. cyanea*, (L.)

Summer-autumn group of 4 species from 2 genera: *Pseudomalus pucillus semicupreus* (Linsenmaier, 1959); *Chrysis interjecta intarjecta* du Buysson, 1895; *C. sardarica* Radoszkowski, 1890; *C. tianshanica* Semenov, 1967. *Pseudomalus pucillus semicupreus* (Linsenmaier, 1959); *Chrysis interjecta intarjecta* du Buysson, 1895; *C. sardarica* Radoszkowski, 1890; *C. tianshanica* Semenov, 1967.

According to the duration of flight, eurychronous species of cuckoo wasps were identified, which are found throughout the season from spring to autumn; mesochronous – the years of which affect the spring-summer or the entire summer period of the season and stenochronous – are confined to a short period of time. Eurychronous were 5 (2.4%): *Hedychridium zelleri*; *Chrysis comparata*; *C. rutilans rutilans*; *C. schencki* and *Trichrysis cyanea* develop in 2-3 generations per season.

Mesochronous – 51 (24.9%) – 2 generations: *Pseudomalus auratus auratus*, *Ps. auratus viridiventris*, *Ps. violaceus*, *Hedychridium ardens ardens*, *H. coriaceum coriaceum*, *H. elegantulum*, *H. erschovi*, *H. roseum roseum*, *H. rossicum*, *Hedychrum gerstaeckeri gerstaeckeri*, *He. gerstaeckeri plicatus*, *He. longicolle*, *He. niemelai*, *He. nobile*, *He. rutilans rutilans*, *Holopyga amoenula amoenula*, *Ho. ignicollis*, *Ho. chrysonota chrysonota*, *Chrysidea disclusa disclusa*, *Ch. pumila*, *Chrysis analis analis*, *C. angustifrons angustifrons*, *C. angustula angustula*, *C. calimorpha calimorpha*, *C. comta*, *C. csikiana*, *C. distincta distincta*, *C. fasciata*, *C. glasunovi*, *C. gracillima gracillima*, *C. graelsii graelsii*, *C. grohmanni krkiana*, *C. idnita ignita*, *C. impressa*, *C. inaequalis*, *C. leachii*, *C. leptomandibularis*, *C. longula longula*, *C. maderi*, *C. mediata mediata*, *C. mesasiatica*, *C. mutabilis mutabilis*, *C. neobule*, *C. placida*, *C. schousboei*, *C. sexdentata sexdentata*, *C. splendidula splendidula*, *C. taczanovskii*, *C. valida*, *Chrysura laevigata laevigata*, *Pseudochrysis neglecta*.

Stenochronous 149 (72.7%) – 1st generation: *Cleptes ignites*, *Cl. insidiosus*, *Cl. nitidulus*, *Cl. radoszkowskii*, *Cl. semiauratus*, *Cl. splendidus*, *Cl. striatipleuris*, *Elampus constrictus*, *El. eversmanni*, *El. foveatus*, *El. panzeri*, *El. pyrosomus pyrosomus*, *El. spina*, *Omalus aeneus*, *O. biaccinctus*, *O. hohlbecki*, *O. stella*, *Philoctetes bidentulus*, *Ph. bogdanovi bogdanovi*, *Ph. conifer*, *Ph. kuznetsovi*, *Ph. sareptanus*, *Pseudomalus bergi*, *Ps. pusillus pusillus*, *Ps. triangulifer*, *Hedychridium aheneum aheneum*, *H. caputaureum*, *H. caucasicum*, *H. chloropygum chloropygum*, *H. cupreum cupreum*, *H. femoratum femoratum*, *H. jucundum*, *H. lucidiventre*, *H. palestinense*, *H. purpurascens*, *H. satunini*, *H. sculpturatum sculpturatum*, *H. scutellare*, *H. trossulus*, *H. uvarovi*, *Hedychrum alexii*, *He. aureicolle aureicolle*, *He. caucasicum*, *He. chalybaeum*, *He. cholodkovskii*, *He. kozhantshikovi*, *He. tobiasi*, *He. virens*, *Holopyga amoenula amoenula*, *Ho. amoenula occidentata*, *Ho. fervida fervida*, *Ho. generosa generosa*, *Ho. inflammata inflammata*, *Ho. jurinei*, *Ho. medvedevi*, *Ho. metallica*, *Ho. mlokosiewitzi*, *Ho. pavlovskii*, *Ho. punctatissima punctatissima*, *Ho. vigora*, *Chrysidea pumila*, *Chrysis aestiva*, *C. bergi*, *C. bicolor*, *C. bilobata*, *C. borealis*, *C. brevitarsis*, *C. caspiensis*, *C.*

caucasicola, *C. cerastes cerastes*, *C. chrysoprasina*, *C. cingulicornis cingulicornis*, *C. circe*, *C. comparata*, *C. corusca*, *C. cylindrica*, *C. dafnis syriensis*, *C. decora*, *C. diacantha diacantha*, *C. equestris*, *C. erivanensis*, *C. frankenbergeri*, *C. frivaldzkyi frivaldzkyi*, *C. frivaldzkyi sparsepunctata*, *C. fulgida*, *C. galloisi*, *C. germari germari*, *C. grumorum*, *C. illigeri*, *C. immaculata*, *C. indigotea*, *C. insperata insperata*, *C. iris*, *C. lanceolata*, *C. longula sublongula*, *C. lyda*, *C. marginata marginata*, *C. mediadentata*, *C. obtusidens obtusidens*, *C. phryne*, *C. poetica*, *C. pseudobrevitarsis*, *C. pulchella pulchella*, *C. ragusae*, *C. ruddii ruddii*, *C. rufitarsis rufitarsis*, *C. rutiliventris rutiliventris*, *C. sardarica*, *C. sculpturata*, *C. scutellaris*, *C. solida*, *C. sooni*, *C. soror*, *C. subcoriacea*, *C. subsinuata fallax*, *C. succincta*, *C. tenella*, *C. tragica*, *C. valesiana valesiana*, *C. vicana*, *C. vinokurovi*, *C. viridula*, *C. zetterstedti*, *C. zonata zonata*, *Euchroeus limbatus limbatus*, *Eu. purpuratus purpuratus*, *Chrysura cuprea cuprea*, *Chr. dichroa dichroa*, *Chr. erigone*, *Chr. filiformis*, *Chr. ignifrons*, *Chr. lydiae lydiae*, *Chr. nikolaji*, *Chr. pseudodichroa*, *Chr. purpleifrons*, *Chr. radians*, *Chr. trimaculata*, *Pseudochrysis aureicollis*, *Ps. humboldti humboldti*, *Ps. uniformis*, *Spinolia chalcites*, *Sp. dournovii*, *Spintarina vagans*, *Stilbum calens*, *St. cyanurum cyanurum*, *Parnopes grandior grandior*.

4 Conclusions

The paper provides data on the dynamics of the abundance of 205 taxa from 19 genera: *Cleptes*, *Colpopyga*, *Elampus*, *Omalus*, *Philoctetes*, *Pseudomalus*, *Hedychridium*, *Hedychrum*, *Holopyga*, *Chrysidea*, *Chrysis*, *Euchroeus*, *Chrysura*, *Pseudochrysis*, *Spinolia*, *Spintarina*, *Stilbum*, *Trichrysis*, *Parnopes*, including species rare and new for the fauna of the North Caucasus and Russia.

By the nature of seasonal activity, five phenological groups of cuckoo wasps were distinguished: spring – represented by 7 species from 4 genera; spring-summer – 76 species from 10 genera; summer – 113 species from 16 genera; summer-autumn – 4 species from 2 genera and spring-summer-autumn – 5 species from 3 genus.

According to the duration of flight, eurychronous species of cuckoo wasps were identified, which are found throughout the season from spring to autumn; mesochronous – the years of which affect the end of May and summer months and stenochronous – confined to a short period of time. Eurychronic accounted for 2.4%, mesochronous 24.9%, stenochronic 72.7%.

The number of generations of cuckoo wasps is related to the dynamics of the host population. In the mountains, the peaks of activity shift towards the middle of summer, most species have one peak of activity; due to the frequent changes in weather conditions in the mountains, the phenological characteristics of the cuckoo wasps and their hosts do not coincide in terms with the lowland populations and the periods of activity can be extended in time. Phenological characteristics of rare and new species for the fauna of the North Caucasus and Russia are presented for the first time.

The mountains have their own complex of species that rarely descend into the lower altitudinal belts, among them there are species that occur from May to August, such as *Chr. ignifrons*. The peak of *C. viridula* activity is in the middle of summer.

A new species for the fauna of Russia, *Spintarina vagans*, was noted by us only in the Central Caucasus at an altitude of 1000 to 2000 m above sea level.

The data obtained expand the understanding of the biodiversity and dynamics of the abundance of cuckoo wasps in the North Caucasus and can be used for environmental protection measures and rational nature management in the south of Russia.

References

1. P. Rosa, A.S. Lelej, S.A. Belokobylskij, N.B. Vinokurov, L.A. Zaytseva. *Entomofauna. Zeitschr. für Entomol.* **23** (2019)
2. A.N. Kilimnik, Coact: the Autor's abstract diss.SRb. (1993)
3. N.B. Vinokurov, Biological plant protection as a basis for stabilizing agroecosystems. Materials of Reports of the Conf., **3**: 28-32 (2004)
4. N.B. Vinokurov, Moscow: association of scientific editions KMK: Scientific publications KMK: 19-21 (2006)
5. A.K. Tembotov, F.A. Tembotova, I.L. Varokova, *Izvestia KBNC RAN*, **2** (1999)
6. N.B. Vinokurov, Proc. Int. Conf. Nalchik KBNC RAN **1**: 89-90 (2005)
7. N.B. Vinokurov, Symposium of Hymenoptera insects from CIS Countries. Moscow: 21 (2006)
8. N.B. Vinokurov, Steppes of Northern Eurasia: V Int. Symp., Orenburg **1**: 206-208 (2009)
9. N.B. Vinokurov, *Proc. Samara Scientific Center RAS* **12** 1(5): 1276-1279 (2010b)
10. N.B. Vinokurov, *Proc. Samara Scientific Center RAS* **13** **1** (5): 1061-1063 (2011a)
11. N.B. Vinokurov, Reserves of Crimea. Biodiversity and nature conservation in the Azov-Black Sea region. Simferopol: 270-273 (2011c)
12. N.B. Vinokurov, *Proc. Samara Scientific Center RAS* **14** (8): 1872-1874 (2012c)
13. N.B. Vinokurov, Mountain ecosystems and their components. Nalchik: 136 (2012e)
14. N.B. Vinokurov, *Proc. Samara Scientific Center RAS* **15** 3(3): 1105-1109 (2013d)
15. N.B. Vinokurov, Materials of the V Conf. Nalchik: 92-93 (2014d)
16. N.B. Vinokurov, Proc. of the III Conf. Samara, PGSGA: 71-79 (2014f)
17. N.B. Vinokurov, The Euro-Asian Symposium on Hymenoptera, Nizhny Novgorod: 19 (2015a)
18. N.B. Vinokurov, *Proc. Samara Scientific Center RAS* **4** (2): 315-320 (2015b)
19. N.B. Vinokurov, *Proc. Ufa Science Center RAS* **3**: 38-41 (2016)
20. N.B. Vinokurov, Proc. Stavropol branch Russian Entomol. Soc. **3**: 23-28 (2007a)

21. N.B. Vinokurov, Actual questions of entomology. Proc. of the IV Conf. Proc. Stavropol Dept. Russian Entomol. Soc. **7**, 113-116 (2011b)
22. N.B. Vinokurov, *Proc. Samara Scientific Center RAS*. **6**: 9-13 (2015c)
23. P. Rosa P., A. Antropov & Z-F. Xu, *Zootaxa* **3990** (1): 1-31 (2015a)
24. P. Rosa P., S.A. Belokobylskij & L.A. Zaytseva, *Proc. Zool. Inst. RAS*, **5** (2017a)
25. P. Rosa, A.S. Lelej, S.A. Belokobylskij, V.M. Loktionov & L.A. Zaytseva In: Lelej A.S., Proshchalykin M. Yu & V.M. Loktionov (Eds.), Annotated catalogue of the Hymenoptera of Russia. V. **1**. Symphyta and Apocrita: Aculeata. Russkaya kolleksiya SPb: (*Proc. Zool. Inst. RAS*, **6**) (2017b)
26. V. Soon & U. Saarma, *Mol. Phylogen. Evol.* **60**: 13-20 (2011)
27. N.B. Vinokurov, *Sci. J. Belgorod State University* **11** (66), 9/1: 82-85 (2009a)
28. N.B. Vinokurov, The fauna of mountain territory. Association of scientific editions KMK, Moscow: 15-26 (2009b)
29. N.B. Vinokurov. Methodology and methods of scientific research in the field of natural science. 63-67 (2006c)
30. V.E. Sokolov, A.K. Tembotov, *Mammalia*. M.: Science. (1989)