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

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Abstract. The work provides data on the dynamics of the abundance of 205 taxa from 19 genera: Cleptes, Colpopyga, Elampus, Omalus, Philoctetes, Pseudomalus, Hedychrium, 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 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 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 Interfluve 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

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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 were recorded in the 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).

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. erschowi (Radoskowski, 1877); H. roseum roseum (Rossi, 1790); H. rossicum Gassakovskij, 1948; Hedychrum aureicolle aureicolle Mocsáry, 1889; He. gerstaeceri gerstaeceri Chevrierm, 1869; He. gerstaeceri plicatus Kilínk, 1993; He. longicolle Abeille de Perrin, 1877; He. niemelai Linsenmaier, 1969; He. nobile (Scopoli, 1763); He. tobiasi Kilínk, 1993; Holopyga amoena amoena Dahlbom, 1845; Ho. amoena occidentata Linsenmaier, 1959; Ho. ignicollis Dahlbom, 1854; Ho. chrysonota chrysonota ( Förster, 1853); Ho. fervida fervida (Fabricius, 1781); Ho. inflammatia inflammatia (Förster, 1853); Ho. jurinei Chevrierm, 1862; Ho. medvedevi Semenov, 1967; Ho. metallica (Dahlbom, 1854); Ho. molkosiewitzi (Radoszkowski, 1877); Ho. pavlovskii Semenov & Nikol’skaya, 1954; Ho. punctatissima punctatissima Dahlbom, 1854; Ho. vigora Linsenmaier, 1959; Chrysidea discjusa discjusa (Linsenmaier, 1959); Ch. pumila (Klug, 1845); Chrysis analis analis Spinola, 1807; C. angustifrons angustifrons Abeille de Perrin, 1878; C. angustula angustula.
in early June; *Chrysura cuprea* cuprea in the Western Caucasus (Kuban version of zonality) 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; *Coloppyga flavipes* flavipes (Eversmann, 1858); *Elampus constrictus* (Förster, 1853); *El. eversmanni* (Mocsáry, 1889); *El. foveatus* (Mocsáry,1914); *El. panzeri* (Fabricius, 1804); *El. pyromos pyromos* (Förster, 1853); *Omalus biaccinctus* (du Buysson, 1892); *O. hohlicheki* (Semenov, 1932); *O. stella* (Semenov, 1932); *Philoctetes bidentulus* (Lepeletier, 1806); *Ph. bogdanovi* bogdanovi (Radoszkowski, 1877); *Ph. conifer* (Semenov, 1932); *Ph. kaznetsovii* (Semenov, 1932); *Ph. serepanus* (Mocsáry, 1889); *Pseudomalus bergi* (Semenov, 1932); *Ps. pululuis pululuis* (Fabricius, 1804); *Ps. triangulifer* (Abeille de Perrin, 1877); *Hedychrium aheneum* aheneum (Dahlbom, 1854); *H. caputaureum* G.Trautmann & W.Trautmann, 1919; *H. caucasicum Trautmann, 1926;* H. chloropygium chloropygium du Buysson, 1888; *H. coriaceum coriaceum* (Dahlbom,1854); *H. cupreum Dahlbom, 1845;* *H. femoratum femoratum Dahlbom, 1854;* *H. jucundum* (Mocsáry, 1889); *H. lucidiventris* Semenov, 1967; *H. palestinense Balthasar, 1946;* *H. purpurascens* (Dahlbom, 1854); *H. saunini Semenov, 196;* *H. sculpturatatum sculpturatatum* (Abeille de Perrin, 1877); *H. scutellare* (Tournier, 1878); *H. trossulus* (Semenov, 1954); *H. uvarovi Semenov, 1967;* *Hedychrum alexii Semenov, 1967;* *H. caucasicum Mocsáry, 1889;* *H. chalybaeum Dahlbom, 1854;* *H. chlokdovski Semenov, 1967;* *H. kozhanishkovi Semenov, 1967;* *H. rutilans rutilans Dahlbom, 1854;* *H. virens Dahlbom, 1854;* *Chrysis aello Semenov & Nikol’skaya, 1954;* *C. aestiva Dahlbom, 1854;* *C. bicolor Lepeletier, 1806;* *C. bilobata Balthasar, 1953;* *C. caspiensis Linsenmaier, 1959;* *C. chrysoprasina Förster, 1853;* *C. chrysostigma Mocsáry, 1889;* *C. cicere Mocsáry, 1889;* *C. comparata Lepeletier, 1806;* *C. decorra Mocsáry, 1887;* *C. disticta distincta Mocsáry, 1887;* *C. distincta thalhameri Mocsáry, 1889;* *C. erivaeinensis Radoszkowski, 1880;* *C. frankenbergeri Balthasar, 1953;* *C. frivaldskyi frivaldskyi 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 Sehnecke, 1980;* *C. irinaeisenis Radoszkowski, 1880;* *C. kozhanishkovi Sehnecke, 1980;* *C. lanceolata du Buysson, 1895;* *C. longula longula Abeille de Perrin, 1879;* *C. lyda Rosa, 2017;* *C. marginata Linsenmaier, 1959;* *C. marginata Mocsáry, 1889;* *C. mediata medianta Linsenmaier, 1951;* *C. obtusidens obtusidens Dufour & Perris, 1840;* *C. phryne Abeille de Perrin, 1878;* *C. poetica Semenov, 1954;* *C. pseudobrevitarsis Linsenmaier, 1951;* *C. rugosae De Stefani, 1888;* *C. ruddii ruddii Schuckard,
Summer-autumn group of 4 species from 2 genera: Pseudomalus pucillus semicupreus (Linsenmaier, 1959); Chrysis interjecta interjecta du Buysson, 1895; C. sardarica Radoszkowski, 1890; C. tianshanica Semenov, 1967. Pseudomalus pucillus semicupreus (Linsenmaier, 1959); Chrysis interjecta interjecta 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 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 Trichrys 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. longicole, Ne. niemelai, He. nobile, He. rutilans rutilans, Holopyga amoena amoena, H. ignicollis, Ho. crysonota crysonota, Chrysidea discusa discusa, Ch. pumila, Chrysis analis analis, C. angustifrons angustifrons, C. angustula angustula, C. caliinsidiosus, C. chrysonota, Chrysidea disclusa disclusa, C. pumila, Chrysis comparata, C. rutilans rutilans; C. schencki and Trichrys cyanea develop in 2-3 generations per season.

Stenochronous 149 (72.7%) – 1st generation: Cleptes ignites, Cl. insidiosus, Cl. nitidulus, Cl. radoszkowski, Cl. semiauratus, Cl. splendidus, Cl. striatipleuris, Elampus constrictus, El. eversmannii, El. foveatus, El. panzeri, El. pyromos pyromos, El. spina, Omalus aeneus, O. biacinctus, O. hohlbecki, O. stella, Philoctetes bidentulus, Ph. bogdanovi bogdanovi, Ph. confir, Ph. kuznetsovi, Ph. sareptanus, Pseudomalus bergii, Ps. pusillus pusillus, Ps. triangulifer, Hedychridium aheneum aheneum, H. caputauraeum, H. cacaisum, H. chloropygum chloropygum, H. cupreum cupreum, H. femoratm femoratm, H. jacundum, H. lucivindert, H. palestinesene, H. purpurascens, H. satunini, H. sculpturatm sculpturatm, H. scutellare, H. trossulus, H. uvarovi, Hedychrum alexii, He. aureicolle aureicolle, He. caucasicum, He. chalybaeum, He. cholodkovskii, He. kozhantsakhvii, He. tobiasi, He. virens, Holopyga amoena amoena, H. amoena occidentata, H. ferdia ferdia, Ho. generosa genera, Ho. inflnammata inflnammata, Ho. jurinei, Ho. medvedevi, Ho. metallica, Ho. mokosiewitz, Ho. pavlovskii, Ho. punctatissima punctatissima, Ho. vigora, Chrysidea pumila, Chrysis aestiva, C. bergi, C. bicolor, C. bilobata, C. borealis, C. brevartis, C. caspiensis, C.
4 Conclusions

The paper provides data on the dynamics of the abundance of 205 taxa from 19 genera: Cleptes, Colpopyga, Elampus, Onalas, Philoctetes, Pseudomalus, Hedychridium, Hedychrum, Holopyga, Chrysidea, Chrysis, Euchoerus, 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 confined to a short period of time. Eurychronous accounted for 2.4%, mesochronous 24.9%, stenochronous 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 Chrysidae. 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.

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