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Features of the Structural and Functional Organization of the Anthophilous Complex of Cuckoo Wasps (Hymenoptera, Chrysididae) in the Conditions of the North Caucasus

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Abstract: The work is devoted to the study of anthophily in cuckoo wasps and the identification of structural and functional features of the formation of the anthophilic complex of cuckoo wasps. The material for the work was thirty years of data obtained during the study of the fauna, ecology and biodiversity of the cuckoo wasps in the North Caucasus. 999 specimens of insects collected on plants most frequently visited by cuckoo wasps were analyzed. The insects were caught with an entomological net. Most often, cuckoo wasps visit flowers of plants of the Euphorbiaceae , Asteraceae and Apiaceae families. For 70 species of cuckoo wasps from 13 genera: Cleptes , Elampus , Philoctetes , Omalus , Pseudomalus , Hedychridium , Holopyga , Hedychrum , Pseudochrysis , Chrysura , Chrysis , Stilbum and Parnopes , relationships with plants during pollen feeding were established, dominant anthophile species were identified, as well as the range of most frequently visited plants. The greatest diversity is found in the complexes of cuckoo wasps on plants of the family Euphorbiaceae (55 species), Asteraceae (22 species) and Apiaceae (26 species). Food specialization is manifested both at the generic and species level. The cuckoo wasps of the genus Holopyga : Ho. fervida , Ho. mlokosiewitzi prefer the milkweeds Euphorbia (Euphorbiaceae), the cuckoo wasps of the genus Hedychrum : He. nobile prefer the yarrows Achillea (Asteraseae), and the representatives of the genus Chrysis : C. scutellaris are more often found on the cutter Falkaria vulgaris (Apiaceae).

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1 INTRODUCTION

It was solely thanks to insects that angiosperms became widespread and began to dominate the plant world.

Flowering plants attract a large number of insects, among which Coleoptera, Diptera and Hymenoptera insects form the core of the anthophilous complex. When studying the fauna, taxonomy, biology and ecology, the method of mowing with an entomological net during the feeding of imago on flowering plants is widely used to collect material from lustrous wasps. To understand the anthophily of lustrous wasps, information about the relationship of lustrous wasps with the plants on which they feed on pollen and nectar is important . Thus, A. Drozdovskaya provides data for 8 species of lustrous wasps feeding on nectar on 6 plant species from 4 families.

An analytical review devoted to the origin and development of anthophilia in insects it covers a wide range of orders and families, but special studies of the manifestation of anthophilia in wasps have not been conducted to date, and the available information is fragmentary.

The work is devoted to the study of anthophily in wasps and the identification of structural and functional features of the formation of the anthophilic complex of wasps .

The material for the work was thirty years of data obtained during the study of the fauna, ecology and biodiversity of wasps in the North Caucasus. 999 specimens of wasps collected from the plants they most often visit were analyzed. The insects were caught with an entomological net.

3 DISCUSSION

The wide range of biocenoses and plant communities where lustrous wasps , parasitizing in the nests of their hosts: Vespidae (Eumeninae), Crabronidae and Megachilidae , occupy certain ecological niches, allows them to be divided into the main specialized ecological groups: xylophiles - associated with dry forest stands; geophiles - hosts live in the soil and anthophiles - associated with feeding on plant pollen as additional nutrition.

The obtained data are of both scientific and practical interest and can be used to understand the evolution of the formation of anthophilia in wasps , to identify the structural and functional features of the formation of xylophilic complexes in wasps , to preserve biological diversity and to rationally manage natural resources.

Shine wasps visit many plant species, but among other families they are most often found in 3 families (Fig. 1).

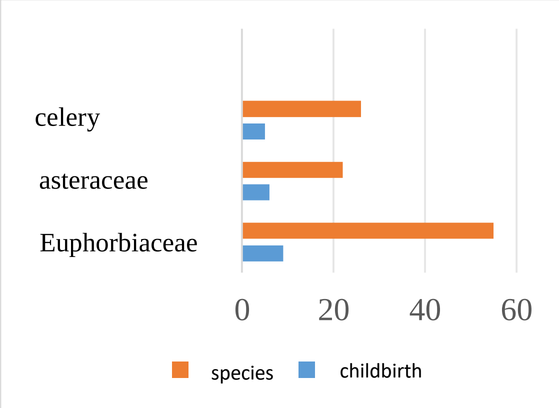

Figure 1: Taxonomic diversity of wasps depending on the plant family.

As can be seen from the diagram (Fig. 1), 55 species of plants of the spurge family (Euphorbiaceae), 22 species of asters, and 26 species of celery or umbelliferous plants have been recorded.

Based on the number of individuals collected on plants feeding on pollen, plants of the spurge family turned out to be more attractive (Fig. 2).

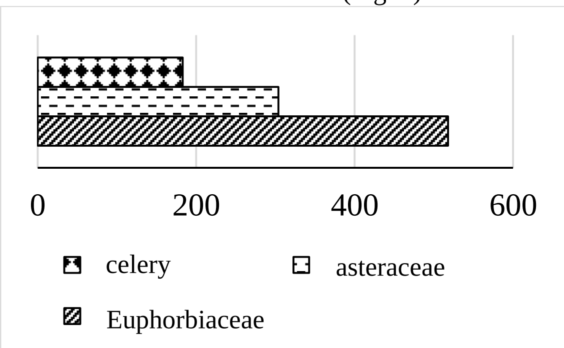

Figure 2: Number of individuals of the splendid wasp recorded in three families of angiosperms.

On the milkweed, 10 species dominated: Holopyga fervida (Fabricius , 1781); Chrysura dichroa dichroa (Dahlbom , 1854); Hedychrum aureicolle (Mocsary , 1889); Chrysis scutellaris Fabricius , 1794; Holopyga mlokosiewitzi (Radoszkowski , 1877); Holopyga amoenula amoenula (Dahlbom , 1854); Chrysura cuprea

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(Rossi , 1790); Chrysis angustifrons angustifrons Abeille de Perrin , 1878; Hedychrum nobile (Scopoli , 1763) (Fig. 3). Their number was (77.2%).

The other 18 species accounted for 14.7% and are often present on milkweed plants: Chrysis mutabilis mutabilis du Buysson , 1887; Holopyga inflammable inflammable Förster , 1854; Holopyga vigor Linsenmaier , 1959; Chrysis soror Dahlbom , 1854; Chrysis Albanian Trautmann , 1927; Chrysis zotata zonata Dahlbom , 1854; Chrysis caucasian Balthasar , 1953; Holopyga ignicollis Dahlbom , 1854; Hedychrum gerstaeckeri gerstaeckeri Chevrier , 1869; Elampus spina (Lepeletier , 1806); Chrysis germari germari Wesmael , 1839; Chrysis chrysostigma Mocsary , 1889; Chrysura purple flowers (Abeille de Perrin , 1878); Chrysis grohmanni krkiana Linsenmaier , 1959; Holopyga punctuation Dahlbom , 1854; Hedychrum niemelai Linsenmaier , 1959; Pseudochrysis neglecta (Schuckard , 1845); Chrysura laevigata laevigata (Abeille de Perrin, 1879).

The group of rare or few-numbered wasps includes 27 species (8.1%), they were recorded 1-2 times during the research period: Chrysura radians (Harris , 1776); Hedychridium aheneum aheneum (Dahlbom , 1854); Holopyga chrysonota (Förster , 1853); Hedychrum longicole Abeille , 1877; Chrysis trimaculata Förster , 1853; Chrysis frivaldszkyi frivaldszkyi Mocsary , 1882; Chrysis interjection interjection du Buysson , 1895; Chrysis indigotea Dufour & Perris , 1840; Pseudochrysis uniformis (Dahlbom , 1845); Cleptes ignitus (Fabricius , 1787); Hedychridium sculpture sculpture (Abeille de Perrin , 1887); Omalus aeneus (Fabricius , 1787); Hedychridium roseum roseum (Rossi , 1790); Holopyga jurinei Chevrier , 1862; Holopyga pavlovskii Semenov & Nikolskaya , 1854; Chrysis calimorpha calimorpha Mocsary , 1889; Pseudochrysis humboldti humboldti (Dahlbom , 1845); Chrysis insperata insperata Chevrier , 1870; Chrysis singulicornis (Förster , 1853); Chrysis placida Mocsary, 1879; Chrysis sexdentate sexdentate Christ , 1791; Chrysis subsidiaries fallax Mocsary , 1882; Chrysis inaequalis Dahlbom , 1845; Chrysis succincta Linnaeus , 1767; Stilbum cyanurum syanurum Forster , 1771; Chrysis analis analis Spinola , 1807; Chrysis marginata marginata Mocsáry, 1889. This situation is connected, in our opinion, with the fact that many representatives of the family are quite rare and large accumulations can be found only in host colonies or during the period of mass flight.

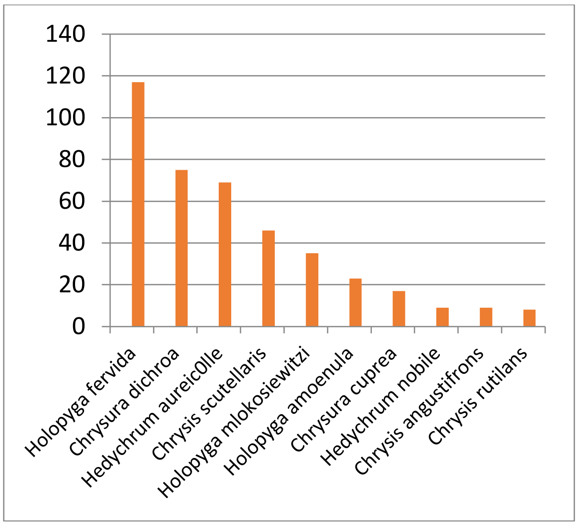

Figure 3: Taxonomic diversity of dominant wasp species on flowers of the Euphorbiaceae family.

Shine wasps feed on pollen on Achillea flowers millefolium L, A. biebersteinii Afan ., Sonchus oleraceus L., Erigeron canadensis L., but prefer Achillea millefolium L., A. biebersteinii Afan . The obtained data are shown (Fig. 4).

On plants of the Asteraceae family, 22 species were noted, of which 6 species were dominant: Hedychrum noble , hedychrum niemilai , hedychrum garstaeckeri , Cleptes ignitus , chrysis angustifrons , hedychridium elegantulum , which accounted for 86.5%. Species: He. nobile and He . niemelai can be classified as a mass species with a clearly expressed food specialization.

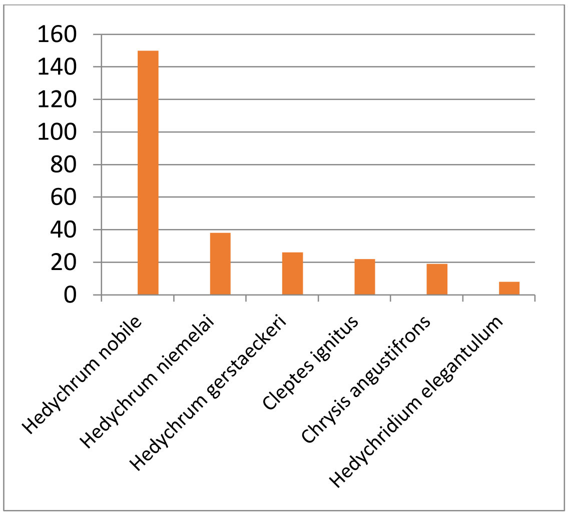

Figure 4: Taxonomic diversity of dominant species of wasps on plants of the Asteraceae family.

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Subdominant species: Pseudochrysis neglecta (Schuckard , 1836); Chrysis mutabilis mutabilis du Buysson , 1887; Hedychrum longicole Abeille , 1877; Hedychrum virens Dahlbom , 1854; Chrysis neobule Semenov , 1967; Chrysura laevigata laevigata (Abeille de Perrin , 1879) and Chrysura cuprea (Rossi , 1790) accounted for 8.9%. Other species: Omalus aeneus (Fabricius , 1787); Hedychridium aheneum aheneum (Dahlbom , 1854); Hedychridium rossicum Gussakovskij , 1948; Hedychridium roseum roseum (Rossi , 1790); Chrysura cuprea (Rossi , 1790); Chrysura laevigata laevigata (Abeille de Perrin , 1879); Chrysis compare Lepeletier , 1806; Chrysis soror Dahlbom , 1854 and Chrysis scutellaris Fabricius , 1794 are rare on yarrow and are noted singly; among them there are species whose numbers are low in other biocenoses, and some species, such as Pseudochrysis neglecta belongs to the group of geophiles , and Chrysura laevigata – to the xylophilic complex and could have ended up on yarrow by accident.

Wasps -shines actively visit flowers of plants of the celery or umbelliferous family, feeding on pollen. Species: Chrysis scutellaris prefers the common cutter Falcaria vulgaris , and Hedycrum rutilans is more common on the common eryngium Eryngium campsite .

On the flowers of the celery family we found 26 species of wasps , among which the dominant species made up 77% (Fig. 5).

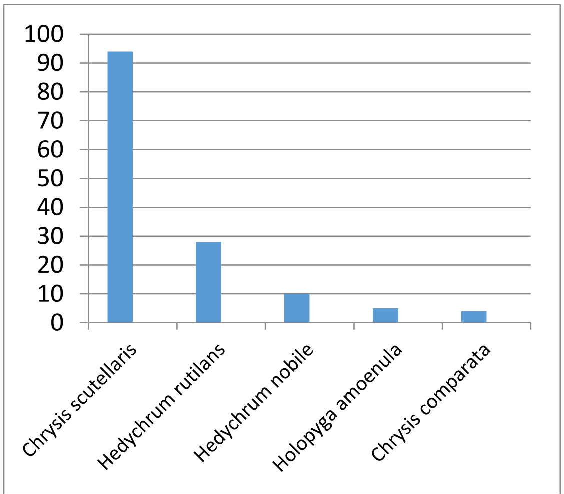

Figure 5: Taxonomic diversity of dominant wasp species on plants of the celery family.

Subdominants include 6 species: Parnopes grandior grandior (Pallas , 1771); Chrysis rutilans rutilans Oliver , 1791; Chrysis angustifrons angustifrons Abeille de Perrin , 1878; Holopyga fervida (Fabricius , 1781); Hedychrum niemelai Linsenmaier , 1959; Chrysis leachii Shuckard , 1837, which made up 10.4%. The remaining 15 species are rare or encountered singly on umbellifers, they made up 12.6%. This group of wasps includes : Chrysis calimorpha calimorpha Mocsary , 1882; Hedychrum longicole Abeille , 1877; Chrysis germari germari Wesmael , 1839; Chrysis grohmanni krkiana Linsenmaier , 1959; Chrysis chrysostigma Mocsary , 1882; Chrysis gracillima gracillima (Förster , 1853); Chrysis taczanovskii Radoszkowski , 1877; Chrysis zonata zonata Dahlbom , 1854; Hedychrum virens Dahlbom , 1854; Chrysis ambigua ambogua Radoszkowski , 187; Chrysis subsidiaries fallaxMocsary , 1882; Chrysis succincta Linnaeus , 1767; Elampus spina (Lepeletier , 1806); Philoctetes bogdanovii bogdanovii (Radoszkovski , 1877); Pseudomalus auratus viridiventris (Mocsary , 1890).

In pollen- feeding wasps, food specialization has been revealed. Among the species of pollen -feeding wasps registered on plant flowers, there are species that visit a narrow and a wider range of plants. In the complex of pollen- feeding wasps collected on plants of the Asteraceae and Euphorbiaceae families , 15 species (19.5%) were common, and on plants of the Euphorbiaceae and Celery families, 16 species (19.7%). On Asteraceae and Celery, there were 7 common species (14.6%), and only 5 species (4.8%) were registered on plants of all families studied.

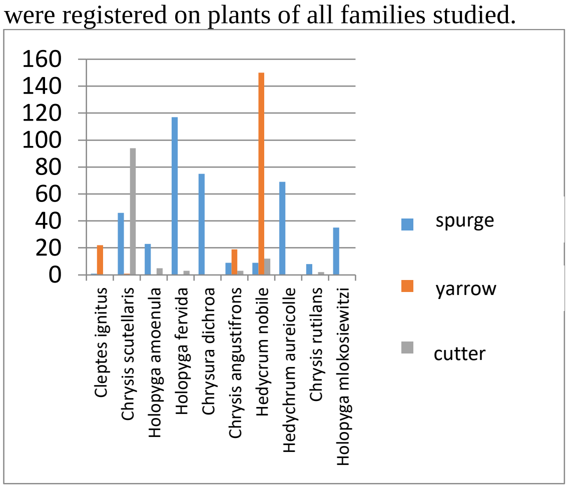

Figure 6: Food specialization in wasps when feeding on flower pollen.

As the results of the research showed (Fig. 6), the species: Cl. ignitus , C. angustifrons , He.nobile prefer to feed on pollen on yarrow, and Ho. fervida , Cr . dichroa , He . aureicolle , Ho . mlokosiewitzi are more often found on milkweed Euphorbia. seguieriana Neck . On the brook-shaped cutter

Falcaria sioides (Web .) is dominated by C. scutellaris .

The synecological indices of Shannon, Simpson and Piel indicate a high diversity of the examined complexes of wasps on flowers of the families Euphorbiaceae, Asteraceae and Celery, taking into account both common and rare species (Fig. 7).

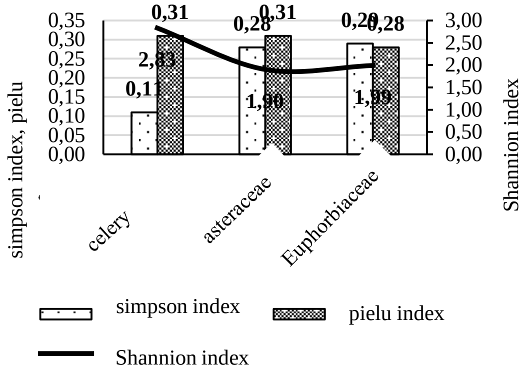

Figure 7: Synecological indices of anthophilous complexes of wasps in relation to their association with different angiosperm families.

The anthophilous complexes of wasps- sparklers confined to the considered families of angiosperms can be considered as specialized, with dominant species and species composition characteristic of each.

4 CONCLUSION

As the results of the research showed, the composition of the wasps-anthophylls was identified , numbering 70 species from 13 genera: *Cleptes* , *Elampus* , *Philoctetes* , *Omalus* , *Pseudomalus* , *Hedychridium* , *Holopyga* , *Hedychrum* , *Pseudochrysis* , *Chrysura* , *Chrysis* , *Stilbum* , *Parnopes* , making up about 30% of the fauna of the North Caucasus.

The greatest diversity is found in the complexes of wasps on plants of the spurge family – Euphorbiaceae (55 species), aster family – Asteraseae (22 species), and celery family – Apiaceae (26 species).

Food specialization is manifested both at the generic and species level. Wasps of the genus *Holopyga prefer Euphorbia* spurges (family Euphorbiaceae), genus *Hedychrum* – yarrow *Achillea* L. (Asteraceae itself), and wasps of the genus *Chrysis* - attracted by the flowers of *the Falcaria cutter sioides* (Wib .) (family Celery).

Cl . ignitus , *C. angustifrons* , *He . noble* prefer to feed on pollen on yarrow, and *Ho . fervida* , *Cr . dichroa* , *He . aureicolle* , *Ho . mlokosiewitzi* on milkweed. On the *cuttlebone F. sioides C. scutellaris* dominates .

Most wasps of the genera *Cleptes* , *Holopyga* , *Hedychrum* , *Chrysura* have the ability to feed on plant pollen. Wasps of the genus *Chrysis* , as being more highly organized in evolutionary development, are less often recorded as anthophiles .

In the ecological aspect, lustrous wasps , feeding on plant pollen, act as an additional protein food as anthophiles , forming specialized complexes in biocenoses, occupying certain ecological niches, maintaining biodiversity and the stable state of ecosystems.

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