Biomorphological analysis and occurance of plant species in the central area of the Way carbon polygon

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Abstract. When studying the biodiversity of regional flora, various floristic studies are carried out. An important role is played by the analysis of plant life forms. Life forms of plants are one of the main characteristics that make it possible to assess the current state of the flora and are an important indicator for assessing the study of the biodiversity of a floristic object. This article provides a biomorphological analysis and occurrence of plant species at the central site of the WAY CARBON carbon test site (in the vicinity of the village of Khoy, Vedeno district, Chechen Republic). The analysis is based on the processing of herbarium materials and field observations of the authors.

1 Introduction

The central site of the carbon training ground "WAY CARBON" of the Chechen State University named after A.A. Kadyrov is located in the Khoisko-Makazhoisk (Cheberloisk) basin in the Vedeno region at altitudes of 1500-1900 m above sea level. Orographically, the polygon is located in the Khoisko-Makazhoisk (Cheberloisk) basin, the wings of which represent the ridge in the north. Kashkerlam (the highest point is the city of the same name Kashkerlam, maximum height 2806.9 m) and ridge. Kerket (heights up to 2391.0 m), in the west – ridge. Baskhoylam (with the peak of the same name, Baskhoylam, 2594.2 m) and ridge. Hindoylam (with the highest point of the same name, Hindoylam, 2658.2 m), in the south – ridge. Abdalzabazul (the highest point of the mountain of the same name is 2604.8 m), in the east are the spurs of the Andean ridge (the highest point is the city of Azal, 2657.9 m). The highest point of this area is the city of Kashkerlam (2806.9 m), the lowest point is at the place where the Ansalta River breaks out of the basin (the height of the edge is 1331.0 m). The amplitude of the terrain height fluctuation is 1475.9 m. The area of the basin is 205 km2 [1].

From 1330-1400 m above sea level up to 2000-2500 m the subalpine belt has boundaries, and on the northern slopes both boundaries are reduced, on the southern slopes they are raised. This is predominantly a meadow belt, although in some places there are birch forests in the depressions of the relief, and on the upper border of the forest there are thickets of Rhododendron luteum, formed as a result of excessive grazing and

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deforestation. Along with meadows and shrubs, tall grass dominated by Heracleum mantegazzianum and Cephalaria gigantea, as well as semi-weedy species Rumex alpinus, Verathrum lobelianum, and species of the genus Cirsium, are common in the lower part of the belt. Among the meadow cenoses, forb-grass groups predominate. The dominant species are Festuca varia, Bromopsis variegata, Phleum montanum, Carex tristis. Forbs include Inula orientalis, Scabiosa caucasica, Gentiana septemfida, Bistorta carnea, Anemonastrum fasciculatum, Trifolium pretense, etc. [3,4].

2 Research Methodology

The material for the work is based on field research and observations of the authors. Route-geobotanical, route-floristic methods were used. The floristic composition and spectrum of life forms were studied during 2022-2023. years by collecting vascular plants. The purpose of this study is to study the biomorphological structure of the flora of vascular plants of the central site of the WAY CARBON carbon test site in the vicinity of the village of Khoy, Vedeno district of the Chechen Republic.

To achieve the set goals, the following tasks were solved: studying the distribution of higher plant species in the study area in accordance with the system of life forms of K. Raunkier. The object of this study is the flora of the surroundings of the village of Khoy, Vedeno district of the Chechen Republic.

The subject of the study is the life forms of plants that make up the biomorphological structure of the flora of the object under study, and their analysis; identification of species that occur commonly, scatteredly, rarely, very rarely. The plant species included in this study number 100 species, selected at the central site of the WAY CARBON carbon test site in the vicinity of the village of Khoy, Vedeno district of the Chechen Republic. This study includes data on the occurrence of the studied species

3 Results and Discussions

According to information obtained during the study, a total of 100 taxa of vascular plants (species and subspecies) belonging to 33 families grow wild in the study area.

The family Asteraceae (Comnositae) has 16 species each, which is 16%. The second place is occupied by the families Fabaceae, Gentianaceae, Lamiaceae include 7 species, which is 7%. In third place are representatives of the family Apiaceae, Primulaceae includes 5 species (5%). Seven families have two species each, which is 2%. 12 families contain one species each (1%).

For botanical and geographical analysis, the system of life forms proposed by the Danish botanist K. Raunkier is used. K. Raunkier's system for dividing life forms is based on one feature - differences in plant adaptation to surviving unfavorable seasons, that is, the location of buds or shoot tips during unfavorable times of the year.

A life form is the result of a plant’s long-term adaptation to local conditions of existence, expressed in its external appearance [1]. The most suitable system for biomorphological analysis is the system of “biological types” by K. Raunkier [9].

Life forms have a significant difference from ecological groups, since they reflect the adaptation of plants not to any one environmental factor, but to a historically formed complex of factors.

The biomorphological spectrum of plant species at the central site of the carbon polygon “WAY CARBON” is presented in Table 1.

Table 1. Biomorphological spectrum of plant species in the central area of the WAY CARBON carbon test site.

BIOMORPHA	**Hk** hemicryptophytes	**T** therophytes	**K** cryptophytes	**Ch** chamephytes	**Phmg** megaphanerophyte	**Phm** microphanerophyte
Number of species	80	4	8	4	3	1
% of total	80	4	8	4	3	1

There are 3 species of megaphanerophytes (3%): Pinus sosnowskyi Nakai (P. hamata (Stev.) Sosn.; P. kochiana Klotzsch) – Sosnowsky Pine, Ostrya carpinifolia Scop. – Common hop hornbeam, Thymus nummularius Bieb. - Thyme coin.

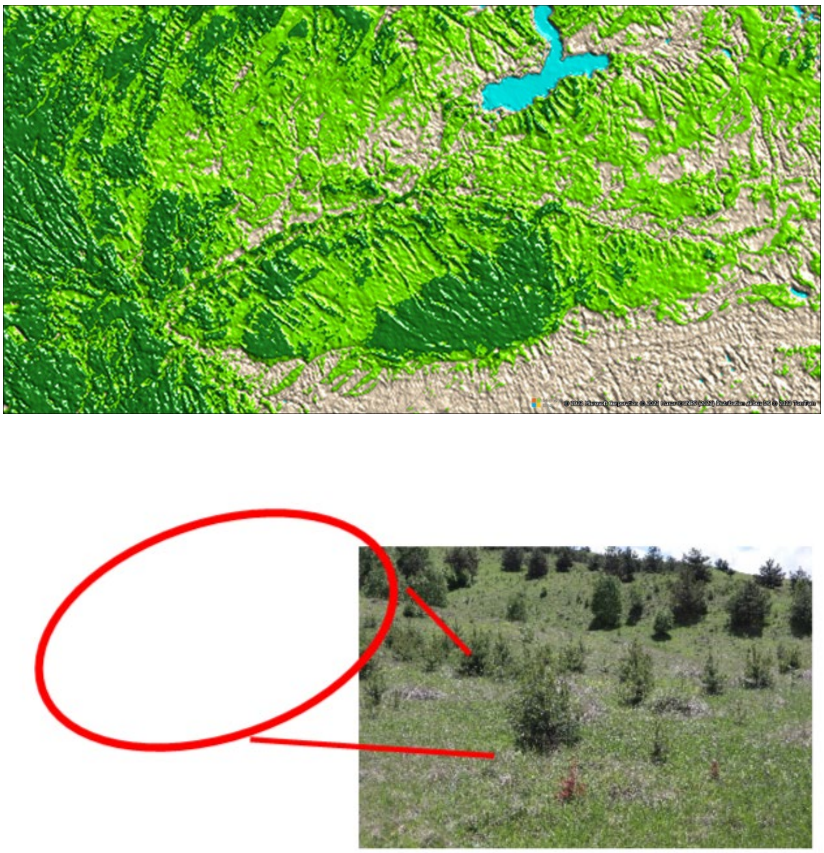

Fig. 1. Megaphanerophytes of the Carboniferous polygon.

There is 1 species of microphanerophytes (1%): Salix caprea L. – Goat willow

There are 4 species of chamaphytes (4%): Teucrium polium L. – White Dubrovnik, Thymus caucasicus Willd. – Caucasian thyme, Th. collinus Bieb. – Ch. Kholmovoy, Th.. daghestanicus Klok.et Shost. – Ch. Dagestansky [7].

There are 80 species of hemicryptophytes (%): Carex tristis Bieb. (C. meinshauseniana V.Krecz.) – Sad sedge, Anthoxanthum odoratum L. (A. alpinum A. et D. Love) – Common fragrant spikelet, Bromopsis variegata (Bieb.) Holub (Z. variegate (Bieb.) Nevski) – Variegated brome, Festuca woronowii Hack. (F. varia auct.) – Crow's fescue, Phleum montanum C. Koch – Mountain timothy, Astrantia trifida Hoffm. – Three-cut astrantia, Daucus carota L. – Wild carrot, Bupleurum falcatum L. – Sickleweed, Heracleum sibiricum

L. – Siberian hogweed, Pimpinella saxifrage L. – Saxifraga, AchiIlea setacea Waldst. et Kit. – Tree bristlecone, Artemisia campestris L. – Artemisia, Centaurea adpressa Ledeb. – Cornflower, C. cheiranthifolia Willd. – V. pale yellow, Cichorium inthybus L. – Common chicory, Cirsium canum (L.) AP. (C. biebersteiniiCharadze) – Gray thistle, C. obvallatnm (Bieb.) Fisch. – B. shrouded, Hieracium umbellatum L. – Umbrella hawkweed, Inula orientalis Lam. – Eastern elecampane, Onopordum acanthium L. – Prickly tartar, Scorzonera filifolia Boiss. – Threadleaf goat, Senecio taraxacifolius (Bieb.) DC. – Dandelion ragwort, Tanacetum vulgare L. – Tansy, Taraxacum officinale Wigg. – Dandelion, Tussilago farfara L. – Common coltsfoot, Aipyanthus echioides (L.) Stev. (Macrotomia echioides (L.) Boiss., Huynhia pulchra (Roem. et Schult.) Greuter et Burdet) – Eehium russicum J.F. Gmel. (E. rubrum Jacq.) – Russian bruise, Symphytum asperum Lepech. – Comfrey, Bunias orientalis L. – Eastern Sverbiga, Cardaria draba (L.) Desv. (Lepidium draba L.) – Cardaria krupka, Campanula elatior (Fomin) Grossh. (C. praealta Galushko) – Tall bell, C. collina Bieb. – K. Kholmovoy, Gadellia lactiflora (Bieb.) Schulkina (Campanula lactiflora Bieb.) – Gadellia lactiflora, Cerastium cerastoides (L.) Britt. — Common carnation, Dianthus arenarius L. – Sandy carnation, Oberna wallichiana Klotzsch – Oberna Wallichiana, Convolvulus arvensis L. – Field flower, Sedum stoloniferum S.G. Gmel. – Sedum, Cephalaria gigantean (Ledeb.) Beaver. – Giant capitate, Scabiosa caucasica Bieb. – Caucasian scabiosa, S. ucranica L. – S. Ukrainian, Amoria ambigua (Bieb.) Sojak (T. ambiguum Bieb.) – Amoria (Clover) fickle, A. repens (L.) C. Presl (T. repens L .) -A. (K.) creeping, Lotus corniculatus L. – Horned grasshopper, Medicago falcate L. – Crescent leaf, Melilotus officinalis (L.) Pall. – Sweet clover, Onobrychis biebersteinii Sirj. – Bieberstein sainfoin, Trifolium pretense L. – Red clover, Gentiana angulosa Bieb. – Angular gentian, G. cruciata L. – G. cruciform, G. dshimilensis C. Koch – G. dzhimilskaya, G. grossheimii Doluch. – G. Grossheim, G. septemfida Pall. – G. seven-parted, G. schistocalyx (C. Koch) C. Koch – G. septatecalyx, Geranium sanguineum L. – Blood-red geranium, Hypericum perforatum L. – St. John's wort, Betonica macrantha C. Koch (B. Grandiflora Willd.) – Large-flowered initial flower, Salvia verticillata L. – Whorled sage, Linum hypericifolium Salisb. – St. John's leaf flax, L. nervosum Waldst. et Kit. – L. veined, PLantago media L. – Medium plantain, Polygala anatolica Boiss. et Heldr. – Anatolian source, Bistorta carnea (C.Koch) Kom. (Polygonum carneum C. Koch) – Bistorta (Buckwheat), Racetoselloides alpines L. – Alpine sorrel, Primula algida Adams – Cold primrose, P. ruprechtii Kusn. – P. Ruprecht, P.cordifolia Rupr. – P. cordifolia, P. luteola Rupr. – P. yellow, P. macrocalyx Bunge – P. large-cupped, Aconitum confertiflorum (DC.) Worosch. – Clump-flowered fighter, Anemonastrum fasciculatum (L.) Holub (Anemone fasciculata L.) – Anemonestrum fasciculata L. – Small cornflower, Trollius ranunculinus (Smith) Steam (T. patulus Salisb.) – Buttercup buttercup, Potentilla reptans L. – Creeping cinquefoil, Rosa tomentosa Smith (R. ciispidata Bieb.) – Rose hip, Galium verum L. – Spring bedstraw, G. mollugo – P. soft, Urtica dioica L. – Stinging nettle, Viola ambigua Waldst. et Kit. – Violet is doubtful [7].

There are 8 species of cryptophytes (8%): Gladiolus tenuis Bieb. (G. apterus Klok.) – Thin skewer, Lilium monadelphum Bieb. – Lily, FritiIlaria collina Adams (F. ophioglossifolia Freyn et Sint.; F. lutea Bieb.) – Hill hazel grouse, Muscari neglectum Guss. (M. muscarimi Medik.; M. racemosum (L.) Mill.) – Unnoticed mouse hyacinth, Dactylorhiza incarnate (L.) Soo (Orchis latifolia L.) – Orchis purpurea Huds. – Purple orchis, O. simia Lam. – I am a monkey, Primula cordifolia Rupr. – Primrose cordifolia [7].

Therophytes 4 species (4%): Nonea rosea (Bieb.) Link – Pink nonea, Draba nemorosa L. – Coppice grouse, Rhinanthus minor L. (R. nigricans Meinsh.) – Small rattle, Rh/ orientalis (L.) Benth . – X. eastern [7].

The biological spectrum of Raunkiera's vegetation is presented in Figure 2.

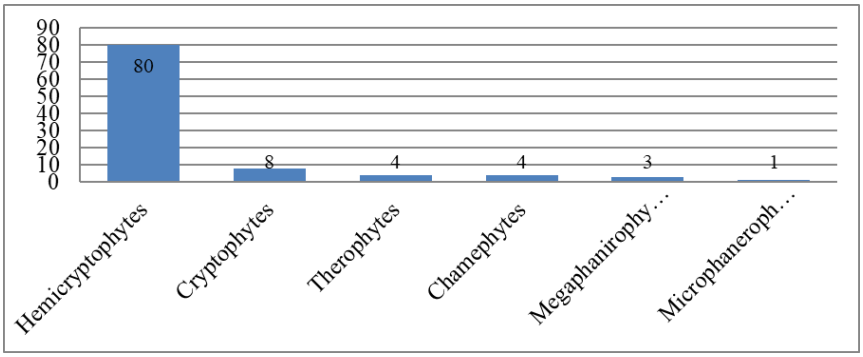

Fig. 2. Biomorphological analysis of plant species in the central area of the WAY CARBON carbon test site.

Understanding patterns of species occurrence and distribution within a study area and across a species' range can help prioritize plant monitoring. An analysis of the occurrence of species relative to the central site of the WAY CARBON carbon test site was carried out.

Species that occur usually, scatteredly, rarely, very rarely were identified in order to determine their habitats. Rare plant species have ecological value and may be rare due to their life cycle.

Roads and trails can spread invasive species into rare species habitats and negatively impact rare plant recruitment and conservation.

Commonly (Plerumque) (57 species, 57%) the following species are found: Pinus sosnowskyi Nakai (P. hamata (Stev.) Sosn.; P. kochiana Klotzsch) – Sosnowsky Pine, Carex tristis Bieb. (C. meinshauseniana V. Krecz.) – Sad sedge, Muscari neglectum Guss. (M. muscarimi Medik.; M. racemosum (L.) Mill.) – Unnoticed Mouse Hyacinth, Festuca woronowii Hack. (F. varia auct.) – Crow's fescue, Daucus carota L. – Wild carrot, Pimpinella saxifrage L. – Saxifraga, AchiIlea millefolium L. – Tree yarrow, Cichorium inthybus L. – Common chicory, Cirsium obvallatnm (Bieb.) Fisch . – Shrouded thistle, Hieracium umbellatum L. – Umbrella hawkweed, Onopordum acanthium L. – Spiny tartar, Senecio taraxacifolius (Bieb.) DC. – Dandelion ragwort, Taraxacum officinale Wigg. – Dandelion, Eehium russicum J.F. Gmel. (E. rubrum Jacq.) – Russian bruise, Symphytum asperum Lepech. – Comfrey, Bunias orientalis L. – Eastern Sverbiga, Cardaria draba (L.) Desv. (Lepidium draba L.) – Cardaria krupka, Draba nemorosa L. – Coppice krupta, Campanula elatior (Fomin) Grossh. (C. praealta Galushko) – Tall bell, Gadellia lactiflora (Bieb.) Schulkina (Campanula lactiflora Bieb.) – Gadellia lactiflora, Cerastium cerastoides (L.) Britt. – Common cornweed, Oberna wallichiana Klotzsch – Auburn Wallichiana, Convolvulus arvensis L. – Field bindweed, Cephalaria gigantean (Ledeb.) Beaver. – Giant capitate, Scabiosa ucranica L. – Ukrainian scabiosa, Amoria ambigua (Bieb.) Sojak (T. ambiguum Bieb.) – Amoria (Clover) fickle, A. repens (L.) C. Presl (T. repens L.) -A. (K.) creeping, Medicago falcate L. – Crescent alfalfa, Melilotus officinalis (L.) Pall. – Sweet clover, Onobrychis biebersteinii Sirj. – Bieberstein sainfoin, Trifolium pretense L. – Red clover, Gentiana angulosa Bieb. – Angular gentian, G. dshimilensis C. Koch – G. dzhimilskaya, G. schistocalyx (C. Koch) C. Koch – G. septaceae, Geranium sanguineum L. – Blood-red geranium, Hypericum perforatum L. – St. John’s wort, Betonica macrantha C. Koch (B. Grandiflora Willd.) – Grandiflora, Salvia verticillata L. – Whorled sage, Teucrium polium L. – White Dubrovnik, Thymus nummularius Bieb. – Monetary thyme, Linum nervosum Waldst. et Kit.– Veined flax, Plantago media L. – Medium plantain, Veronica gentianoides Vahl – Veronica gentian, Polygala anatolica Boiss. et Heldr. – Anatolian source, Bistorta carnea (C.Koch) Kom. (Polygonum carneum C. Koch) – Bistorta (Buckwheat), Racetoselloides alpines L. – Alpine sorrel, Primula algida Adams – Cold

primrose, P.cordifolia Rupr. – P. cordifolia, P. ruprechtii Kusn. – P. Ruprecht, Aconitum confertiflorum (DC.) Worosch. – Crowed-flowered fighter, Thalictrum minus L. – Small cornflower, Potentilla reptans L. – Creeping cinquefoil, Galium verum L. – Spring bedstraw, Salix caprea L. – Goat willow, Rhinanthus minor L. (R. nigricans Meinsh.) – Small rattle, Urtica dioica L. – Stinging nettle, Viola ambigua Waldst. et Kit. – Violet is doubtful [7].

32 species (32%) occur scatteredly (Sparse): Gladiolus tenuis Bieb. (G. apterus Klok.) – Thin skewer, Lilium monadelphum Bieb. – Lily, FritiIlaria collina Adams (F. ophioglossifolia Freyn et Sint.; F. lutea Bieb.) – Hill grouse, Anthoxanthum odoratum L. (A. alpinum A. et D. Love) – Common fragrant spikelet, Bromopsis variegata (Bieb .) Holub (Z. variegate (Bieb.) Nevski) – Variegated brome, Phleum montanum C. Koch – Mountain timothy, Astrantia trifida Hoffm. – Three-cut astrantia, Bupleurum falcatum L. – Crescent hogweed, Heracleum sibiricum L. – Siberian hogweed, AchiIlea setacea Waldst. et Kit. – Bristlewood tree, Artemisia campestris L. – Artemisia, Centaurea cheiranthifolia Willd. – Pale yellow cornflower, Cirsium canum (L.) AP. (S. biebersteiniiCharadze) – Gray thistle, Inula orientalis Lam. – Eastern elecampane, Tanacetum vulgare L. – Common tansy, Aipyanthus echioides (L.) Stev. (Macrotomia echioides (L.) Boiss., Huynhia pulchra (Roem. et Schult.) Greuter et Burdet) – Apianthus, Nonea rosea (Bieb.) Link – Pink nonea, Scabiosa caucasica Bieb. – Caucasian scabiosa, Lotus corniculatus L. – Horned grasshopper, Gentiana aquatic L. – Water gentian, G. cruciata L. – G. cruciform, G. grossheimii Doluch. – G. Grossheim, G.. septemfida Pall. – G. seven-parted, Thymus caucasicus Willd. – Caucasian thyme, Linum hypericifolium Salisb. – St. John's leaf flax, Primula luteola Rupr. – Yellow primrose, Anemonastrum fasciculatum (L.) Holub (Anemone fasciculata L.) – Anemone strum, Trollius ranunculinus (Smith) Steam (T. patulus Salisb.) – Buttercup, Rosa tomentosa Smith (R. ciispidata Bieb.) – Rose hip felt, Rhynchocorys orientalis (L.) Benth. – Oriental proboscis [7].

Rare (Raro) are 7 species (7%): Dactylorhiza incarnate (L.) Soo (Orchis latifolia L.) – Dactylorhiza incarnate (L.) Soo (Orchis latifolia L.) – Ostrya carpinifolia Scop. – Common hop hornbeam, Sedum stoloniferum S.G. Gmel. – Sedum, Thymus collinus Bieb. – Ch Kholmovoy, Th. daghestanicus Klok.et Shost. (77g. mashukensis Klok.) – Ch. Dagestan, Galium mollugo – Soft bedstraw [7].

Very rarely (Rarissimo) there are 4 species (4%): Orchis purpurea Huds. – Purple orchis, Centaurea adpressa Ledeb. – Cornflower, Scorzonera filifolia Boiss. – Threadleaf goat, Dianthus arenarius L. – Sandy carnation [7].

Some species of rare plants found in areas of the carbon polygon are presented in Fig. 3.

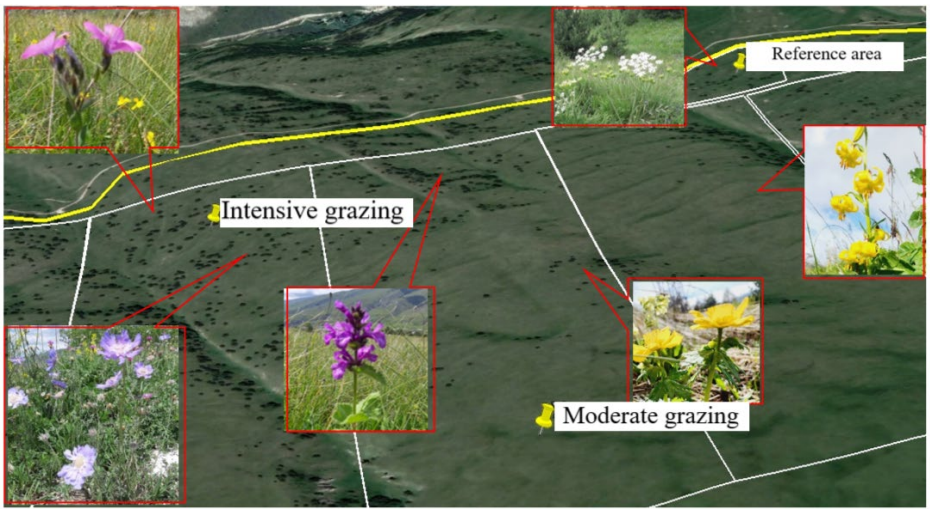

Fig. 3. Rare plant species in areas of the carbon polygon.

Table 2. Occurrence of plant species in the central area of the WAY CARBON carbon polygon.

№	Occurrence	Number of species	% of total number of species
1.	Soc. – dominates	0	0
2.	PL – usually	57	57
3.	Sp. – absent-mindedly	32	32
4.	Raro – rare	7	7
5.	Rs. - very rarely	4	4

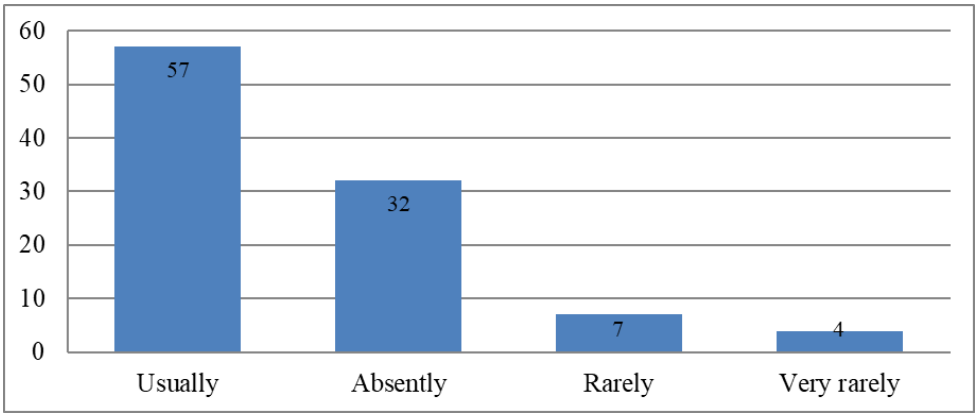

Fig. 4. Percentage distribution of the occurrence of plant species in the central area of the WAY CARBON carbon polygon.

4 Conclusions

Hemicryptophytes are represented by 80 (80%) species, cryptophytes by 8 species (8%), therophytes by 4 species (4%), chamephytes by 4 species (4%), megaphanerophytes by 3 species (3%) and microphanerophytes by 1 (1%). The largest number of species are found usually (57 species), scattered (32 species), 7 species are rare, 4 species are very rare.

Acknowledgments

The work was carried out as part of the implementation of the state assignment FEGS-2023-0008.

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