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Phenological Spectra and Ecological Family of Seasonal Development of Orthopterans: A Case Study from Jizzakh Province, Uzbekistan

Z. Izbasarova
"Center for Ecological Information, ITT and Multimedia" State Unitary Enterprise, Bunyodkor Ave. 7A, Tashkent, Uzbekistan, 100043

E-mail: z.izbasarova@eco.gov.uz

Sh. Khalillaev
National University of Uzbekistan named after Mirzo Ulugbek, University str. 7, Tashkent, Uzbekistan, 100174

M. Medetov
Institute of Zoology, Uzbekistan Academy of Sciences, Bogishamol str. 232B, Tashkent, Uzbekistan, 100053

ABSTRACT

The period of seasonal development of 66 orthopteran insects identified from different landscapes of Jizzakh province, Uzbekistan was determined. By studying the patterns of their formation, the ecological adaptation to the food environment and the phenological spectra of anthropogenic and natural zones of the region were determined, which makes it possible to timely control harmful species in environmental forecasting. It has been established that the phenological spectrum belongs to 4 groups. From this, 30% of these species overwinter as adults and larvae, 12% as ephemeroid and early spring species, 46% as spring-summer species, and 12% as summer-autumn species. Eremobionts make up 16.7% of the life form of orthopteran insects; facultative chortobionts 15.1%; tamnobionts 13.6%; fissurebionts 7.6%; chortobionts, herpetobionts, petrobionts, spiny chortobionts 6.1%; herbivorous chortobionts 4.5%; prickly chortobionts, specialized phytophils, stratified geophiles, geobionts 3%; cryptobionts, flying migrants, and microtamnobionts accounted for 1.5%.

***Key words*:** humidity, process, deformation, horizontal expansion, flyer, priming, circuit, pressure depth, diameter zone, stamp, border.

Introduction

It is important to study the orthopteran species by dividing them into groups according to their phenological characteristics. Many scientific investigations have been conducted in this regard. In particular, the main purpose of our study on the phenological features of Jizzakh province, Uzbekistan

is to know the dynamics of seasonal development. It consists in knowing the effect of abiotic factors on the formation of the ecological adaptation among the habitats of birds, as well as the development of ways to predict the increase of harmful species and to organize the fight against them in a timely manner.

Literature review

Based on the data of literature analysis, there are more than 45,000 species of arachnid insects, and more than 700 of them are distributed in Central Asian countries, especially in the Republic of Uzbekistan [7].

R.A. Alimdzhanov [1], A.A. Bekuzin [3], N.E. Ergashev [10], F.A. Gapparov [4], A.A. Nurzhanov [8], M.J. Medetov [6] and other researchers conducted investigations on the species composition and systematics of Uzbek orthognathics. However, the conducted researches cannot provide enough information about the species composition, distribution, and zoogeography of the insect species of Jizzakh province. Accordingly, in the conditions of Jizzakh province, it is of great scientific and practical importance to determine the species composition and taxonomic structure of the insect fauna, its ecological adaptation, the influence of abiotic factors on the formation of its fauna, as well as to predict the increase of harmful species and to develop ways to organize the fight against them in a timely manner.

Materials and methods

In this current study, the samples of stilt insects were collected and studied from the mountain, highland, hill, desert and different agro-ecosystems of Jizzakh province. Also, along the routes, insect samples were collected from stations or different biotopes, they were entomologically processed and a collection was prepared.

During 2018-2022, the data was collected from the designated plots in different regions of Jizzakh province. Collecting insect specimens used accepted general entomological methods and approaches developed for taxa [2]. To determine the taxonomic structure of orthopteran insects, the identifiers “Locusts of Kazakhstan, Central Asia and adjacent territories” [5], and “Patterns of distribution of Orthopteran insects of North Asia” [9] were used for locusts and crickets.

Results and discussion

It is important to know the effect of abiotic factors on the ecological adaptation of ungulates in their habitats, the formation of their fauna, as well as to predict the increase of harmful species and to develop ways of timely organization of countermeasures. Based on this, according to the results of our research on the bio-ecology of the stilts of the studied area, when we analyzed the characteristics of their phenological spectrum, they were divided into 4 groups (Figure 1).

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Figure 1. Orthopteran family distribution according to phenological spectrums in sorghum fields of Jizzakh province, Uzbekistan.

The **first group** is species that overwinter as imago and larva. The phenology of this group is very diverse. It is observed that several generations per year are given in species that belong to the group. In some years, it is difficult to determine which group the populations of the species belong to. Most of the wintering insects are distributed in the Old Mediterranean and trophic continents.

Wintering species are found in all landscapes of the Valley. These species are considered to be species that have adapted as a result of evolutionary development to the sudden change of the primary annual cycles and seasons that have occurred over the years, or that have entered from trophic and subtrophic regions. These are *Melanogryllus desertus* Pall., *Modicogryllus bordigalensis* Latr., *Tartarogryllus tartarus* Sauss, *Turanogryllus lateralis* (Fied.), *Eremogryllodes semenovi* (Mir.), *Gryllotalpa grullatalpa* L., *Tetrix bolivari* Saul., *Tetrix subulata* L., *Tetrix tartara tartara* (I. Bol.), *Tetrix tartara subacuta* B.-Bien., *Pyrgomorpha bispinosa deserti* B.-Bien., *Conophyma semenovi semenovi* Zub., *Conophyma sokolovi decorum* Mistsh., *Anacridium aegyptium* (L.), *Truxalis eximia* Eichw., *Duroniella gracilis* Uv., *Duroniella kalmyka* (Ad.), *Acrotylus insubricus* (Scop.), *Notostaurus albicornis* (Ev.), *Chorthippus* (G.) *apricarius* (Lin.).

In the conditions of Jizzakh province, there are representatives of the large family of shrikes, among which are *Melanogryllus*, *Modicogryllus*, *Tartarogryllus*, *Turanogryllus*, *Eremogryllodes*, and *Grullatalpa* genera that winter in the cracks of the ground, under the ditches along the ditches, under the fields covered with plants, under the floors of houses, in storerooms and hibernates in the imago and larval stages. *Velarifictorus bolivari* winters under rocks in the mountain area. Representatives of the large family of grasshoppers make up 56% of the wintering species in the area. Of these, species of the genera *Pyrgomorpha*, *Truxalis*, *Duroniella*, *Acrotylus*, *Notostaurus*, and *Chorthippus* winter among perennial vegetation in anthropogenic and mostly natural areas. Here, there is a favorable microclimate for them.

The wild plants around the field are set on fire and the years when the winter is cold have a serious effect on them. The species of *Conophyma* genus are considered mountain endemics, and the years when the vegetation cover of the mountain is thick are favorable for them. *Anacridium aegyptium* is known to overwinter in mostly anthropogenic areas. This species overwinters mainly in backyards, roofs, barns, perennial trees, sometimes in the nests of vertebrates only in the imago phase.

During our research, we did not identify species that winter in the conditions of Jizzakh province, Uzbekistan from the members of the large family of temirchaks.

The **second group** is *Ephemeroid* or early spring species. The species of this group hatch in the third decade of March or the first decade of April. At this time, the temperature is not so high, but it is a favorable climate for the larvae of the beetles, and it coincides with the times when ephemeroid plants are widespread for feeding. These species lay eggs by the end of May, at which time several ephemeral plants complete their growing season. *Glyphonothus thoracicus* (Fischer-Waldheim), *Asiotmethis heptapotamicus* Zub., *Pezotmethis nigrescens* Pyln., *Pezotmethis tartarus tartarus* (Sauss.), *Pezotmethis ferghanensis* (Uv.), *Dociostaurus* (s.str.) *maroccanus* (Thnd.), *Dociostaurus* (s.str.) *tartarus* (Stshelk.), and *Pyrgodera armata* F.d.W. are included to this group.

The **third group** is spring-summer species. The species of this group hatch from the second decade of April to the first day of May. At the time of appearance of these species, ephemerals correspond to the end of the vegetation period and the awakening period of shrubs and small bushes or plant species that start their vegetation period early. They lay their eggs in late June to early August. This group of species is considered to be stiltgrass, which is mainly distributed in open areas and thickets. *Tettigonia caudata* (Charp.), *Tettigonia viridissima* L., *Semenoviana plotnikovi* (Uv.), *Decticus verrucivorus* (Lin.), *Decticus albifrons* F., *Gampsocleis glabra* (Herbst), *Platycleis intermedia* (Aud.-Serv.), *Phaneroptera falcata* (Poda,1761), *Oecanthus turanicus* Uv., *Calliptamus italicus italicus* L., *Calliptamus turanicus* Serg.Tarb., *Calliptamus barbarus cephalotes* (Costa), *Locusta migratoria migratoria* L., *Oedipoda caerulescens* L., *Oedipoda miniata miniata* (Pall.), *Mecostethus alliaceus turanicus* Serg.Tarb., *Helioscirtus moseri* Sauss., *Aiolopus oxianus* Uv., *Oedaleus decorus* (Germ.), *Chorthippus* (s.str.) *albomarginatus karelini* (Uv.), *Chorthippus* (s.str.) *dichrous* (Ev.), *Mioscirtus wagneri* (Kitt.), *Bruntridactylus tartarus* Sauss., *Sphingonotus nebulosus* Uv., *Sphingonotus maculatus maculatus* Uv., *Sphingonotus satrapes* Sauss., *Sph.salinus* (Pall). *Pseudosphingonotus savignyi* (Sauss.), *Ramburiella foveolata* Serg., *Eremippus simplex* are the good representations of this group.

The **fourth group** is summer-autumn species. This group includes species that hatch from eggs in the last decade of May or mid-June and live until the end of autumn. These species live among thick bushes or perennial plants. *Oxya fuscovittata* (Marsch.), *Heteracris adspersa* (Redt.), *Heteracris littoralis littoralis* Ramb., *Acrida oxycephala* (Pall.), *Heteracris pterosticha* (F.d.W.), *Aiolopus thalassinus thalassinus* F., *Eyprepocnemis unicolor* Serg.Tarb., *Eyprepocnemis plorans* Charp. Are involved in this group.

These phenological calendars can change by up to 15 days in the mountainous regions of Jizzakh province depending on the air temperature of the year. If we look at the calendar of phenological development in different landscapes of Jizzakh province, Uzbekistan, it is known that in the mountainous region (Zaamin administrative district) 25-35 days delay is reached. This is characteristic of all the above-mentioned phenological groups.

It is ecologically important to study 66 stilt insects distributed in natural and anthropogenic areas of Jizzakh province according to their life form. Also, several studies have been conducted in this regard. In particular, F.N. Pravdin [49]

studied the way of life of insects of this category had a significant impact on their external morphological appearance. Based on this, the life forms of the insects of the study area were mainly divided into 16 groups (Figure 2).

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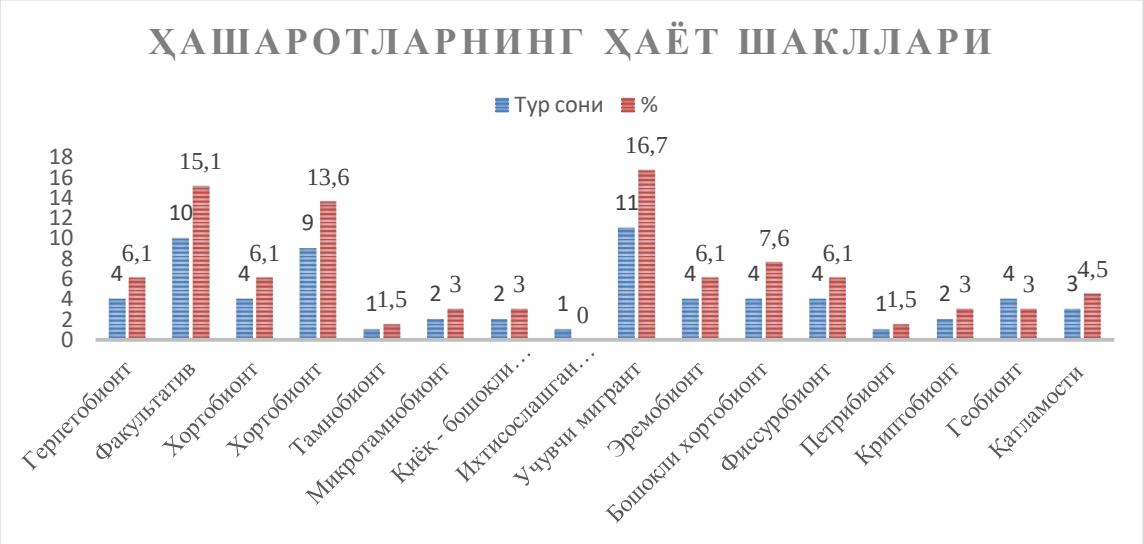

Figure 2. Life forms of aphids.

Herpetobiont (mesophylls that feed on organic debris) according to the life form of strabismus such as *Tetrix bolivari*, *T tartara subacuta*, *Tetrix tartara tartara*, *Tetrix tartara subacuta*, facultative hortobiont (species living on the surface of the soil, in open areas) such as *Duroniella gracilis*, Duroniella kalmyka, *Aiolopus thalassinus*, *Aiolopus oxianus*, *Notostaurus albicornis*, *Dociostaurus tartarus*, *Dociostaurus maroccanus*, *Pyrgomorpha bispinosa deserti*, *P. Intermedia*; *Oxya fuscovittata*, *Calliptamus turanicus*, *Calliptamus italicus italicus* L., *Calliptamus barbarus cephalotes* – hortobionts (species that differ in body structure, adapted to live in the station of spiky plants); *Eyprepocnemis unicolor*, *Heteracris adspersa*, *Heteracris pterosticha*, *H. littoralis*, *Anacridium aegyptium*, *Caudata, T. viridissma, Eyprepocnemis plorans, Glyphonothus thoracicus* – tamnobiont (tree and shrub species); *Mioscirtus wagneri*, *Oedipoda caerulescens*, *Oedipoda miniata miniata*, *Acrotylus insubricus*, *Sphingonotus nebulosus*, *Sph. satrapes*, *Sph. salinus*, *Sph. maculatus maculatus*, *Helioscirtus moseri*, *Pseudosphingonotus savignyi*, *Pyrgodera armata* – eremobionts (species associated with wet soil surfaces in open areas); *Ramburiella foveolata* Serg., *Mecostethus alliaceus turanicus*, *Chorthippus albomarginatus karelini*, *Chorthippus dichrous* – spiked hortobiont; *Modicogryllus bordigalensis*, *Melanogryllus desertus*, *Tartarogryllus tartarus*, *Turanogryllus lateralis* – fissurobiont (species that live in the cracks and cavities of soil cavities); *Asiotmethis heptapotamicus*, *Pezotmethis tartarus tartarus*, *Pezotmethis ferghanensis*, *Pezotmethis nigrescens* – petrobiont; *Eremogryllodes semenovi* – cryptobiont (adapted to live in rodent burrows); *Locusta migratoria migratoria* – migrate; *Semenoviana plotnikovi*, *Conophyma semenovi semenovi*, *Conophyma sokolovi decorum* – herbivorous hortobiont; *Truxalis eximia*, *Acrida oxycephala* – sedge hortobiont (species that feed on reeds and sedges in riparian groves); *Decticus verrucivorus*, *Decticus albifrons*, *Gampsocleis glabra*, *Oedaleus decorus* – stratified geophile; *Gryllotalpa gryllotalpa* L., *Bruntrydactilus tartarus* – geobiont (species that live in the upper layers of the soil); *Eremippus simplex* – microthamnobiont; *Phaneroptera falcata*, *Oecanthus turanicus* was found to be a specialized phytophile (species adapted to living in the uppermost layer of grasses and lawns).

Conclusions and recommendations

According to the phenological spectrum of the seasonal development period of the insects of Jizzakh province, they belong to 4 groups: among them – imago and larva wintering 30%, ephemeroid and early spring species 12%, spring-summer species group 46% and summer-autumn species group 12% belonging to eremobionts are 16.7% according to the life form of arachnid insects; facultative hortobionts 15.1%; thamnobionts 13.6%; fissurobionts 7.6%; hortobionts, herpetobionts, petrobionts, spiked hortobionts 6.1%; herbivorous hortobionts 4.5%; spiky hortobionts, specialized phytophiles, stratified geophiles, geobionts 3%; cryptobionts, flying migrants, and microtamnobionts made up 1.5%.

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