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RESEARCH ARTICLE
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Species Composition and Seasonal Activity Fluctuations of Insect Pests Affecting the Generative Organs of Saxaul (*Haloxylon Ammodendron*) and Pasture Plants in South-Eastern Kazakhstan

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ABSTRACT

Insect pests that damage pasture plants' reproductive organs and seeds significantly affect plant communities by disrupting the natural regeneration of vegetation. In south-eastern Kazakhstan, which is characterised by a dry climate and strong anthropogenic pressure, this leads to the degradation of pastures. It is therefore important to investigate the biotic factors that influence plant productivity in these ecosystems. The research was conducted from 2019 to 2023 in the desert pastures of south-eastern Kazakhstan. The study covered sandy, rocky and saline steppes, all of which have an arid climate and extreme temperatures. The main plant species studied were *Haloxylon ammodendron* and various pasture plants, including *Artemisia terrae-albae, Bassia prostrata, Eurotia ceratoides, Camphorosma songorica,* and *Salsola orientalis*. Insect sampling was carried out using route surveys and standard entomological methods. The study identified 96 insect pests from five orders (Hemiptera, Diptera, Lepidoptera, Coleoptera, and Thysanoptera) representing 16 families. Based on their food preferences, 26 species were categorized as polyphagous, 25 as oligophagous, and 45 as monophagous. The greatest species diversity was observed among insects that damage seeds, seedlings, shoots and reproductive plant structures. Based on their seasonal activity, insect pests attacking the reproductive organs and seeds of saxaul (*Haloxylon ammodendron*) and pasture plants were categorized into three groups: indirect pests, free-living pests and hidden pests. It was found that insect pests that attack the generative organs and seeds of saxaul and pasture plants have a significant impact on their reproductive capacity and the dynamics of plant communities. The communities of *Haloxylon ammodendron* and *Artemisia terrae-albae* were the most susceptible and experienced periodic outbreaks of specialized phytophagous insects. These results contribute to the development of strategies for biological pest control and sustainable pasture management.

Keywords: Insect pests, Species composition, Pasture plants, Saxaul, Desert zone, Seasonal activity fluctuations, Trophic relationships.

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INTRODUCTION

In recent decades, climate change has emerged as one of the greatest threats to ecosystems worldwide (Malhi et al., 2020; Zafar et al., 2025). Regions with extreme natural conditions, such as the desert areas of Kazakhstan, which cover more than 120 million hectares, are particularly vulnerable to these changes (Yerkin et al., 2022). Rising average temperatures, decreasing precipitation and more frequent droughts and sandstorms are accelerating desertification and the degradation of natural ecosystems (Bolatova, 2023; Salnikov et al., 2023). These climatic changes threaten not only the ecological stability of the desert regions, but also the sustainability of agricultural activities, which are crucial for the livelihoods of the rural population.

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Kazakhstan has extensive grazing areas with over 180 million hectares of agricultural land, 68% of which is located in desert and semi-desert areas (Nasiyev et al., 2022). Despite their relatively low productivity (1.5–4.0 quintals per hectare), these pastures serve as the main source of fodder for livestock and cover up to 80–90% of the annual fodder requirements in the south-eastern and southern regions. This contributes to food security and biodiversity conservation. Research by Robinson et al. (2021) suggested that desert pastures in Kazakhstan offer significant potential for the expansion of sheep and camel farming. However, the increasing impacts of climate change combined with growing human pressure pose a major risk to the stability of these ecosystems.

One of the main threats to pastoral ecosystems is the rapid spread of insect pests, whose population size and activity fluctuate significantly over the seasons (Sridhar et al., 2020; Muluneh, 2021). These pests directly affect the productivity of pastures by feeding on or developing in various plant structures such as stems, twigs, shoots, leaves, roots, flowers and seeds. This leads to plant degradation, shorter life cycles and a reduction in plant cover. The main pests attacking pasture plants in Kazakhstan include aphids, pests of *Haloxylon ammodendron* and various species of grasshoppers, including *Calliptamus italicus, Locusta migratoria* and *Dociostaurus maroccanus* (Azhbenov et al., 2024). Grasshoppers are among the most destructive pests, as they reproduce rapidly and form huge swarms in dry years, devouring large areas of pasture vegetation. Their ability to feed on almost all types of grasses and shrubs makes them a serious threat to pasture ecosystems. In addition, beetles from the Cerambycidae family develop inside the stems of saxaul (*Haloxylon ammodendron*), boring tunnels through the wood and weakening the plant structure, making it more susceptible to wind damage and disease (Sreedevi et al., 2022). These insects not only affect the health of individual plants, but also reduce the overall density of Saxaul populations, leading to further loss of pastureland.

Other pests, such as beetles from the Tenebrionidae family, feed on young shoots and leaves and slow down the natural regeneration of willows (Mordkovich et al., 2020). Cutworm larvae develop in the soil and feed on the roots of grasses and legumes, weakening the plants and reducing their resistance to drought. Aphids and thrips suck plant sap from leaves and shoots, disrupting photosynthesis and inhibiting plant growth (Yatsyuk et al., 2020; Zafar et al., 2020). Their populations tend to explode in years with mild winters and early spring, when survival rates are higher.

Studies on insect pests in Kazakhstan date back to the 1950s. The research was initiated by the Laboratory of Entomology at the Institute of Zoology of the Academy of Sciences of the Kazakh SSR and focused mainly on phytophagous insects in the southern regions of the country (Abukenova et al., 2022). A study by Nyrmyratov et al. (1997) identified 167 insect species infesting vegetation in the desert regions of south-eastern Kazakhstan, including monophagous beetles specialized on specific plants and polyphagous species feeding on a wide range of local flora. However, no new data on insect species in this part of Kazakhstan have been obtained since this study.

Further research has identified 26 aphid species from 14 genera of the family Aphididae, including the subfamilies Eriosomatinae and Aphidinae that infest pasture plants and their role in shaping the dynamics of plant communities in arid ecosystems (Kadyrbekov, 2024). Baibussenov et al. (2021) investigated factors influencing the reproduction of non-aggregative grasshopper pests in northern Kazakhstan and emphasized the role of environmental factors, especially weather conditions, in grasshopper population dynamics. Their results emphasize the need for early prediction and effective pest control measures. In addition, Kansman et al. (2020) investigated the effects of water stress on host selection and feeding behavior of aphids and concluded that mild water stress can attract aphids due to increased nutrient concentrations in the phloem, while severe water stress deters aphids by reducing phloem pressure and making it more difficult for them to feed effectively.

The desert flora of Kazakhstan, including important pasture plants such as saxaul, plays a crucial role in feeding livestock and maintaining ecological balance. However, the ongoing spread of insect pests threatens the long-term sustainability of these plants. Mombayeva et al. (2024) investigated the morphobiological and ecological characteristics of Coleoptera pests in the desert regions of southeastern Kazakhstan. Their research identified ecological groups of beetles that feed on different organs of *Haloxylon ammodendron*, resulting in significant seed losses. These insects, together with grasshoppers, aphids, cutworms and seed bugs, can reduce seed availability by up to 70 %, severely hampering natural regeneration processes and increasing the risk of desertification (Vilela et al., 2020; Maity et al., 2023).

Another major challenge in pest control is the limited presence of natural predators that regulate pest populations (González-Chang et al., 2019). This imbalance is exacerbated by changing climatic conditions, which influence pest population dynamics by altering temperature, humidity and the duration of dry periods. Such unpredictable fluctuations complicate the development and implementation of effective control strategies and increase the vulnerability of pasture ecosystems (Skendžić et al., 2021). The scarcity of biological control agents emphasizes the need for integrated pest management strategies that include sustainable approaches such as the introduction of natural predators, habitat conservation and targeted biological control measures.

Ecological concerns aside, the economic impact of pest infestations on Kazakhstan's desert pastures is significant. The degradation of pasture vegetation has a direct impact on livestock productivity as less fodder is available, resulting in lower animal weight gain and lower wool and meat yields. This leads to significant financial losses for farmers and pastoral communities

who rely on these resources. In addition, reliance on alternative feed sources to compensate for the loss of grazing land increases production costs and makes livestock farming less profitable.

Given these pressing challenges, there is an urgent need for comprehensive research on the biodiversity and seasonal population dynamics of insect pests that attack saxaul and other important pasture plants in the desert zone of south-eastern Kazakhstan. A detailed understanding of pest species composition, feeding relationships and population fluctuations is essential for the development of effective pest control strategies. Such studies will help to identify the most susceptible periods for plant-pest interactions and provide insights into the ecological factors that lead to pest outbreaks.

The aim of this study is to analyse the species composition, feeding relationships and population dynamics of insect pests infesting the reproductive organs of *Haloxylon ammodendron* and pasture plants in the desert region of Kazakhstan.

MATERIALS & METHODS

Study Area and Materials

The research was conducted from 2019 to 2023 in the desert zone of south-eastern Kazakhstan (Fig. 1). The selected sites included natural shrub pastures and saxaul groves, which include sandy, rocky and saline steppe ecosystems with different soil compositions. The region is characterized by an arid climate, low annual rainfall, high summer temperatures and significant seasonal temperature fluctuations.

The main subjects of this study were shrub-grazing plants, including Artemisia terrae-albae (white sagebrush), Bassia prostrata (L.) Beck (1909) (shrubby summer cypress), Eurotia ceratoides (L.) S. A. Mey (shrubby buckwheat), Haloxylon ammodendron (saxaul), Camphorosma songorica Bunge (1879) (Camphorosma), Salsola orientalis S.G. Gmel. (keyreuk). The study also analysed the species diversity of insect pests (Insecta), including both polyphagous and monophagous species that feed on the reproductive organs of these plants.

Coordinates of monitoring sites:

1. «Qum basy «Qaroı»»: latitude - 43°45'54.64"C, longitude - 77° 2'37.48"
2. «Eski Aıdarly»: latitude - 44° 7'58.86"C, longitude - 75°52'11.85"B
3. «Aq saksaýl togaıy»: latitude - 44°15'57.08"C, longitude - 75°19'28.58"B
4. «Qara sekseil togaıy»: latitude - 44°16'11.75"C, longitude - 73° 3'37.30"B
5. «Moıynqum»: latitude 44° 5'22.29"C, longitude - 72°45'51.56"B
6. «Qara sekseyil togaıy, Qaroı»: latitude - 45°51'17.91"C, longitude - 74°50'1.56"B
7. «Bura»: latitude - 44°55'25.14"C, longitude - 75°59'49.70"B
8. «Quraqsy»: latitude - 46° 0'2.35"C, longitude - 78°18'43.79"B
9. «Koltaban»: latitude - 46° 4'11.04"C, longitude - 78°51'3.66"B
10. «Lepsi dalasy»: latitude - 46°14'44.51"C, longitude - 78°34'1.79"B
11. «Aqtobe», MUTP «Altynemel»: latitude - 43°57'12.24"C, longitude - 78°47'4.41"B.

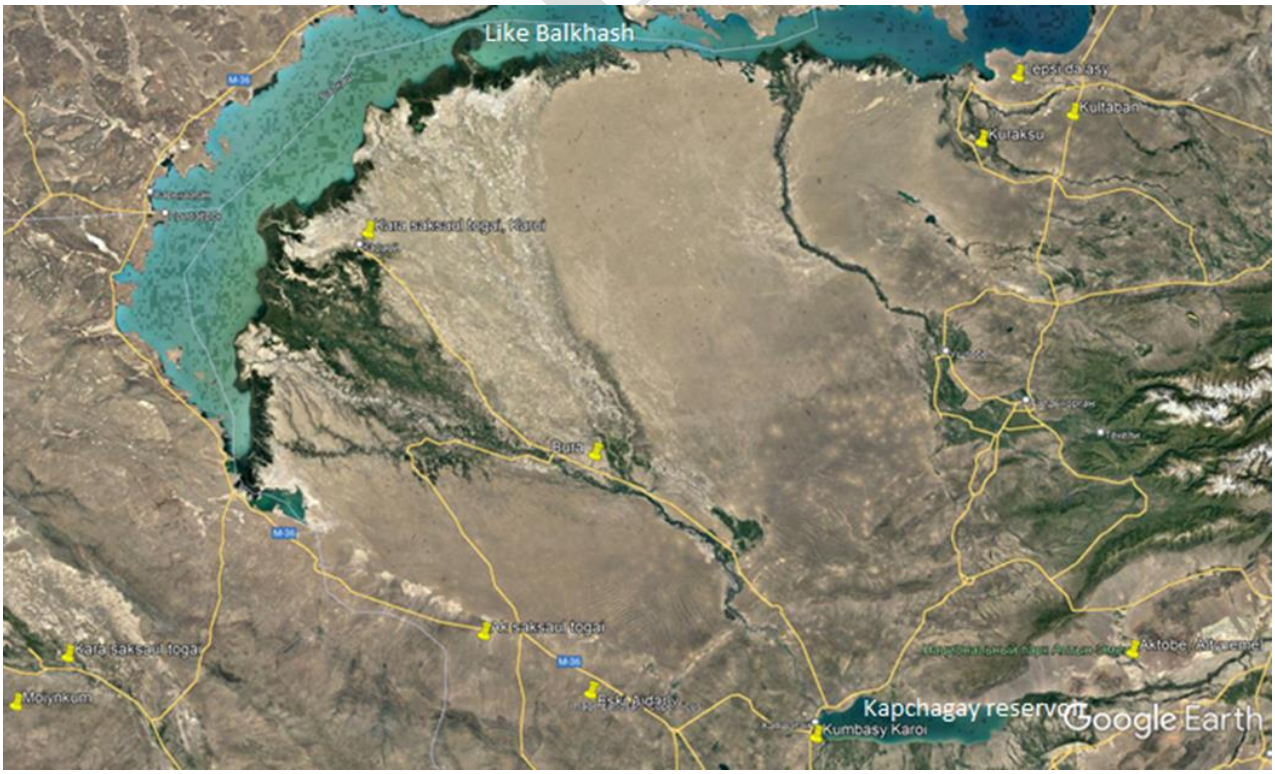

Fig. 1: Research routes.

Insect Sampling and Identification

Entomological field surveys were carried out using standard methods described in the legal documents (MUK 4.2.1479-03, 2021) and the recommendations of the Kazakhstan Research Institute of Plant Protection and Quarantine (PPQI) 2023. Species identification and population assessment were carried out using established entomological methods according to the methods of Montgomery et al. (2021). Some modifications were made: Caterpillar feeding was monitored at night, and adult insects were trapped using a petrol generator with a power of 1 kW and a 500 W fluorescent lamp (Fig. 2, a). To estimate the total number (population density) of Lepidoptera caterpillars on specific plant parts, the average number of caterpillars per tree was calculated based on a sample of 10 trees (Fig. 2, b).

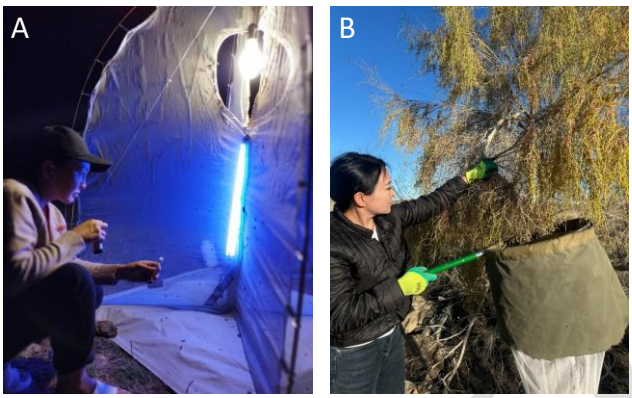

Fig. 2: Methods for nocturnal monitoring of caterpillar feeding (a) and estimation of lepidopteran caterpillar population density (b).

In autumn, the total number of seeds and the extent of seed damage were determined. From the collected seed mass, 1 kg was selected (Fig. 3). Using the quartering method, a selected portion of the seeds was taken for further analysis of damage and germination, as described by Tumenbayeva et al. (2016).

Fig. 3: Assessment of seed damage and germination using the quartering method.

The collection of material was carried out at all stages of the insect pest life cycle, including the adult (imago), larval and pupal stages. Traps and specialized equipment were used to catch adult insects on plants, while larvae and caterpillars were collected from damaged plant parts, such as seeds and fruits.

The collected materials were preserved for further morphological analysis: Adult insects were preserved in a 70% ethanol solution, while larvae and caterpillars were preserved in similar solutions. The pupae were kept in glass containers under controlled conditions to allow them to develop into adults (imago), which enabled the recording of their morphological characteristics and the identification of species.

Evaluation of Feeding Relationships between Insects and Plants

To assess the impact of insect pests on plant reproductive structures, a comprehensive analysis of their feeding preferences was carried out. Each insect species was classified according to its feeding habits. Some species fed exclusively on flowers, others exclusively on seeds, while some ate both flowers and seeds. In addition, certain species fed on reproductive shoots, while others targeted different reproductive organs of the plants. Field observations were carried out during the main reproductive stages of the plants, including flowering, seed formation and maturation. The extent of damage caused by insect damage was categorized into three levels of severity: light damage, where seed loss was less than 10%; moderate damage, where seed loss was between 10% and 50%; and severe damage, where more than 50% of the seeds were destroyed.

Monitoring the Insect Population

Insect populations were monitored regularly throughout the growing season to analyze seasonal dynamics, population fluctuations and environmental influences. Data collection focused on plant phenology and tracked different stages such as germination, flowering, fruiting and seed maturation. Climatic factors such as temperature fluctuations, rainfall and soil moisture were also recorded. The study also investigated how variations in vegetation and soil types at the different sites affect insect populations and the plants' susceptibility to pest infestation.

RESULTS

Species Composition and Feeding Relationships of Insect Pests Damaging Saxaul and Pasture Plants in the Deserts of South-eastern Kazakhstan

As a result of the research to identify insect pests that damage the reproductive organs and seeds of saxaul and pasture plants, a detailed species list was compiled. It includes 96 species of insect pests from 5 orders and 16 families within the class Insecta. These include:

Order Hemiptera: 3 species of the family Dictyopharidae, 3 species of the Cicadellidae, 1 species of the Coccoidea, 11 species of the Aphidoidea and 9 species of the Heteroptera.

Order Thysanoptera: 3 species from the family Phlaeothripidae.

Order Coleoptera: 12 species from the family Meloidae and 3 species from the family Curculionidae.

Orer Diptera: 17 species of the Cecidomyiidae.

Order Lepidoptera: 1 species of the family Tortricidae, 24 species of the family Coleophoridae, 2 species of the family Gelechiidae, 1 species of the family Pyralidae, 1 species of

the family Geometridae, 4 species of the family Noctuidae and 1 species of the family Orgyidae.

Based on their association with plant organs: 27 species feed exclusively on flowers, 1 species on reproductive shoots, 12 species on both flowers and seeds, 14 species on reproductive organs, 1 species on both reproductive organs and seeds, and 41 species feed exclusively on seeds. The list also includes species that damage reproductive organs as they have a significant impact on plant productivity. Damaged plants have stunted growth, which impairs their ability to reproduce by seed. Based on their food specialisation, 26 insect pest species were identified as polyphagous, 25 as oligophagous and 45 as monophagous. The species composition of the monophagous pest insects is shown in Table 1. This table contains 45 monophagous pest species belonging to 4 orders and 6 families. The greatest species diversity was observed among insects that damage seeds, seedlings, shoots and reproductive organs of plants. The order Hemiptera, including the family Aphididae, is closely associated with Bassia prostrata (L.) Beck (1909) and Camphorosma songorica Bunge (1879). Aphids primarily attack the reproductive organs, significantly reducing seed productivity and limiting the natural regeneration of host plant populations. The specialised feeding dependence of mirids and phlaeothripids on flowers and reproductive organs indicates their strong influence on plant reproduction, seed formation and germination rates.

Table 1: Species composition of insect pests that damage the reproductive organs and seeds of pasture plants, classified as monophagous

№	Species	Damaged plants	Damaged organs
	Order - HEMIPTERA		
	Family - Aphidoidea		
1	*Brachycaudus eurotiae* (Mamontova, 1968)	*Eutoria ceratoides*	generative organs
2	*Chaitaphis camphorosmae* (Hille Ris Lambers, 1959)	*Camphorosma songorica*	generative organs
3	*Chaitaphis tenuicauda* Nevsky, 1928	*Bassia prostrata*	generative organs
4	*Eichinaphis pamirica* Narzikulov, 1963	*Eutoria ceratoides*	generative organs
5	*Eichinaphis turanica* Kadyrbekov, 1992	*Eutoria ceratoides*	generative organs
6	*Xerobion camphorosmae* (Tashev, 1964)	*Camphorosma songorica*	generative organs
7	*Xerobion eriosomatinum* Nevsky, 1928	*Bassia prostrata*	generative organs
	Heteroptera		
	Family - Miridae		
1	*Phytocoris turkestanicus* Poppius, 1912	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers, seeds
	Order -THYSANOPTERA		
	Family - Phlaeothripidae		
1	*Haplothrips kochia* Jakh.	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
	Order - DIPTERA		
	Family - Cecidomyiidae		
1	*Contarinia kochiae Fedotova,1988*	*Bassia prostrata*	seeds
2	*Halodiplosis infestans* (Marikovskij, 1955)	*Haloxylon ammodendron*	flowers, seeds
3	*Halodiplosis inornata* (Marikovskij, 1955)	*Haloxylon ammodendron*	flowers, seeds
4	*Halodiplosis propria* (Marikovskij, 1955)	*Salsola orientalis*	seeds
5	*Halodiplosis stakelbergi* (Marikovskij, 1955)	*Haloxylon ammodendron*	flowers, seeds
6	*Halodiplosis urceolatus* Fedotova, 1988	*Bassia prostrata*	seeds
7	*Halodiplosis vernalis* (Marikovskij, 1955)	*Haloxylon ammodendron*	flowers, seeds
8	*Halodiplosis vicina* (Marikovskij, 1955)	*Bassia prostrata*	seeds
9	*Izeniola potanini* (Fedotova, 1982)	*Bassia prostrata*	seeds
10	*Janetiella gemmicola* Marikovskij, 1961	*Eutoria ceratoides*	flowers
11	*Pseudokochiomyia vicina* (Marikovskij, 1961)	*Bassia prostrata*	seeds
12	*Pseudokochiomyia mesasiatica* (Fedotova, 1982)	*Bassia prostrata*	seeds
13	*Pseudokochiomyia taranovii* Fedotova, 1992	*Bassia prostrata*	seeds
14	*Stefaniola camphorosmae* Fedotova, 1992	*Camphorosma songorica*	seeds
	Order - LEPIDOPTERA		
	Family - Coleophoridae		
1	*Aporiptura keireuki* (Falkovitsh, 1970)	*Salsola orientalis*	seeds
2	*Aporiptura hypomona* Falkovitsh, 1979	*Salsola orientalis*	seeds
3	*Aporiptura macilenta* Falkovitsh, 1972	*Eutoria ceratoides*	seeds
4	*Aureliana psamata* (Falkovitsh, 1973)	*Salsola orientalis*	seeds
5	*Carpochena ceratoidis* Falkovitsh, 1979	*Eutoria ceratoides*	seeds
6	*Carpochena dilabens* Falkovitsh, 1972	*Salsola orientalis*	seeds
7	*Carpochena echinacea* (Falkovitsh, 1972)	*Eutoria ceratoides*	seeds
8	*Casignetella arenifera* Falkovitsh, 1989	*Artemisia terrae-albae*	flowers, seeds
9	*Characia haloxyli* (Falkovitsh, 1972)	*Haloxylon ammodendron*	seeds
10	*Coleophora caroxyli* Falkovich, 1970	*Salsola orientalis*	seeds
11	*Coleophora cyrta* (Falkovich, 1973)	*Salsola orientalis*	seeds
12	*Coleophora psamata* Falkovich, 1973	*Bassia prostrata*	seeds
13	*Coleophora schinacea* Flkv.	*Eutoria ceratoides*	seeds
14	*Ecebalia psammodes* Flkv.	*Salsola orientalis*	seeds
15	*Ecebalia tecta* (Falkovich, 1989)	*Bassia prostrata*	seeds
16	*Ecebalia tornata* (Falkovich, 1989)	*Bassia prostrata*	seeds
17	*Ecebalia villosa* Flkv.	*Bassia prostrata, Camphorosma songorica*	generative organs
18	*Ionescumia izenella* Flkv.	*Bassia prostrata*	seeds
19	*Ionescumia sacsauli* Flkv.	*Haloxylon ammodendron*	seeds
20	*Ionescumia pagodella* Flkv.	*Salsola orientalis*	seeds
21	*Tritemachia captiosa* (Falkovitsh, 1972)	*Haloxylon ammodendron*	seeds
	Family - Gelechiidae		
1	*Euscrobipalpa alterna* (Falkovitsh & Bidzilya, 2006)	*Eutoria ceratoides*	seeds

The family Cecidomyiidae, which is represented by numerous species in the table, plays a key role in causing specific structural damage to host plant tissues. Their feeding on seedlings and reproductive organs causes morphological changes that reduce the competitiveness of plants in dry climates. The large number of species associated with *Salsola orientalis, Haloxylon ammodendron* and *Artemisia terrae-albae* indicates close feeding relationships and considerable pressure of these herbivorous insects on the reproduction of these plants. The families Coleophoridae and Gelechiidae feed mainly on the seeds, leaves and reproductive organs of the host plants. Their herbivorous behavior has a significant impact on the dynamics of plant communities by disrupting seed reproduction and limiting the plants' ability to regenerate. The species *Aporipture keiruki, Aporipture hypomona, Carpochena dilabens* and *Characia haloxyli* are closely associated with *Salsola orientalis* and *Haloxylon ammodendron*, which indicates their adaptation to dry conditions.

The species composition of the insect pests classified as oligophages based on their dietary specialization is shown in Table 2. A total of 25 oligophagous insect species belonging to 5 orders and 12 families were identified that damage plant communities. They damage important plant species such as *Artemisia terrae-albae, Bassia prostrata, Eurotia ceratoides, Haloxylon ammodendron, Camphorosma songorica* and *Salsola orientalis* by damaging the reproductive organs, flowers, shoots, seedlings and seeds. This has an impacts on the natural regeneration of plant communities. The study revealed that most species belong to the order Hemiptera, including Aphidoidea and Miridae. Their high adaptability to environmental conditions and their ability to spread rapidly under favorable conditions explain their dominance.

Cecidomyiidae and Coleophoridae are of particular interest as they damage seedlings, seeds and reproductive organs of dominant plants such as Artemisia terrae-albae, Bassia prostrata, Eutoria ceratoides and Haloxylon ammodendron. Their detrimental effects are due to their ability to form galls and damage seeds, which reduces the natural regeneration of plant communities. The data suggest that oligophagous insects play an important role in shaping plant population structures. They can help regulate the numbers of certain plant species by acting as natural controllers. However, when their populations overgrow, they can cause plant stress and degradation,

Table 2: Species composition of insect pests that damage the reproductive organs and seeds of pasture plants, classified as oligophagous

№	Species	Damaged plants	Damaged organs
Order - HEMIPTERA			
Family - Dictyopharidae			
1	*Nymphorgerius plotnikovi* Kusnezov, 1928	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
Family - Cicadellidae			
1	*Handianus imperator* Dlabola, 1961	*Bassia prostrata*	generative organs
Family - Aphididae			
1	*Macrosiphoniella seriphidii* Kadyrbekov, 2000	*Artemisia terrae-albae*	generative organs
2	*Macrosiphoniella terraealbae* Kadyrbekov, 2000	*Artemisia terrae-albae*	generative organs
3	*Xerobion cinae* (Nevsky, 1928)	*Artemisia terrae-albae*	generative organs
Heteroptera			
Family - Miridae			
1	*Atomoscelis onusta* Fieber, 1861	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
2	*Solenoxyphus lepidus* (Puton, 1874)	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
Order - THYSANOPTERA			
Family - Phlaeothripidae			
1	*Haplothrips arthrophyti* Yakhontov, 1956	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
2	*Haplothrips mordvilkoi (*John, 1925)	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
Order - COLEOPTERA			
Family - Curculionidae			
1	*Anthypurinus transversus* (Faust, 1885)	*Haloxylon ammodendron*	seeds
2	*Baris memnonia* Porta, 1932	*Bassia prostrata, Eutoria ceratoides*	generative shoots
3	*Phytonomus campestris* Petri, 1901	*Bassia prostrata, Eutoria ceratoides*	seeds
Order - DIPTERA			
Family - Cecidomyiidae			
1	*Pupascleromyia novitzkii* Fedotova, 2001	*Artemisia terrae-albae*	flowers, seeds
2	*Rhopalomyia baudysi* Vimmer, 1928	*Artemisia terrae-albae*	seeds
3	*Rhopalomyia heteropalpis* (Marikovskij, 1964)	*Artemisia terrae-albae*	seeds
Order - LEPIDOPTERA			
Family - Coleophoridae			
1	*Casignetella gallivora* Falkovitsh, 1970	*Haloxylon ammodendron*	seeds
2	*Coleophora magyarica* Baldizzone, 1983	*Bassia prostrata, Camphorosma songorica*	seeds
3	*Coleophora polynella* Falkovich, 1972	*Artemisia terrae-albae*	flowers, seeds
Family - Gelechiidae			
1	*Gelechia* sp. 1	*Bassia prostrata*	seeds
Family - Pyralidae			
1	*Thospia permixtella* (Ragonot, 1888)	*Salsola orientalis*	seeds
Family - Geometridae			
1	*Eupithecia exactata* Staudinger, 1882	*Eutoria ceratoides*	seeds
Family - Noctuidae			
1	*Cardepia irrisoria* (Erschov, 1874)	*Haloxylon ammodendron*	flowers, seeds
2	*Pseudohadena chenopodiphaga* (Rambur, 1832)	*Haloxylon ammodendron*	seeds
3	*Hadena ptochica* Püngeler, 1899	*Haloxylon ammodendron*	flowers, seeds
4	*Scythocentropus scripturosa* (Eversmann, 1854)	*Haloxylon ammodendron*	seeds

especially in dry ecosystems. Polyphagous insects are a group of pests with a broad dietary specialisation that can damage different plant species. The species composition of insect pests categorised as polyphagous, which damage the reproductive organs and seeds of pasture plants, is shown in Table 3. During the study, 26 species of polyphagous insects belonging to three main orders were identified: Hemiptera– - 6 families, 12 species; Coleoptera – 12 species; and Lepidoptera – 2 species.

The greatest diversity of species can be observed in the order Hemiptera, especially within the families Miridae, Cicadellidae and Aphidoidea. These herbivorous insects damage the reproductive organs of plants, reducing their reproductive potential and productivity. The family Miridae such as *Adelphocoris lineolatus, Lygus gemellatus* and *Psallopsis kirgisicus* feed mainly on flowers. In contrast, aphids (*Aphis craccivora*) and cicadas (*Handianus eurotiae; Hardya turanica*) attack reproductive organs and seeds, which significantly impairs the natural regeneration of plant populations.

Order Coleoptera are represented by the family Meloidae, whose larvae and adults actively feed on plant flowers. The greatest threat is posed by the species Mylabris, including *Mylabris amoenula, Mylabris calida* and *Mylabris ocellata*. When these insects reproduce in large numbers, they can significantly reduce the number of reproductive organs in plants such as *Bassia prostrata, Eutoria ceratoides* and *Haloxylon ammodendron*. Order of the Lepidoptera are represented by the families Tortricidae and Orgyidae. Phtheochroa subfumida damages the seeds of Haloxylon ammodendron, while *Orgyia dubia* attacks the reproductive organs and seeds of several plant species, including *Bassia prostrata, Eurotia ceratoides, Haloxylon ammodendron* and *Salsola orientalis*. This can have a negative impact on the stability of the ecosystem, especially in arid regions where plant cover has difficulty recovering. Based on their seasonal development and their impact on the reproductive organs and seeds of *Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron* and *Artemisia terrae-albae*, the main insect pests are categorized into three groups: indirect pests, free-living pests and hidden-living pests.

The group of indirect pests consists of insects whose biological development is not directly linked to the plants under investigation. They visit these plants at certain times in order to obtain additional food. The seasonal fluctuations in activity of the indirect pest insects are shown in Fig. 4. In spring and summer, they feed on the generative organs of *Haloxylon ammodendron*, and in autumn they consume the seeds. This group includes mainly polyphagous and oligophagous insects that are widely distributed in desert ecosystems. The most common

Table 3: Species composition of insect pests that damage the reproductive organs and seeds of pasture plants, classified as polyphagous

№	Species	Damaged plants	Damaged organs
Order - HEMIPTERA			
Family - Dictyopharidae			
1	*Chanithus pannonicus* Germar, 1830	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
2	*Sphenocratus* sp.	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers, seeds
	Family - Cicadellidae		
1	*Handianus eurotiae* Emeljanov, 1964	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers, seeds
2	*Hardya turanica* Zachvatkin, 1946	*Bassia prostrata , Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	generative organs
	Family - Coccoidea		
1	*Atrococcus achilleae* Kiritchenko, 1936	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
	Family - Aphididae		
1	*Aphis craccivora* Koch, 1854	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron, Salsola orientalis*	generative organs
	Heteroptera		
	Family - Miridae		
1	*Adelphocoris lineolatus* Goeze, 1778	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
2	*Deraeocoris punctulatus* Fallen, 1807	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
3	*Lygus gemellatus* (Herrich-Schaeffer, 1835)	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
4	*Plagiognathus albipennis* (Fallen, 1829)	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
5	*Polymerus cognatus* Fieber, 1858	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
6	*Psallopsis kirgisica* (Becker, 1864)	*Bassia prostrata, Eutoria ceratoides, Artemisia terrae-albae, Haloxylon ammodendron*	flowers
Order - COLEOPTERA			
Family - Meloidae			
1	*Hycleus scabiosae* (Olivier, 1811)	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
2	*Mylabris amoenula* Menetries, 1849	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
3	*Mylabris calida* (Pallas, 1782)	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
4	*Mylabris maculata* Olivier, 1795	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
5	*Mylabris crocata* (Pallas, 1781)	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
6	*Mylabris elegantissima* Zoubkov, 1837	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
7	*Mylabris intermedia* Fischer von Waldheim, 1844	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
8	*Mylabris mannerheimi* Gebler, 1837	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
9	*Mylabris magnoguttata* Heyden, 1881	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
10	*Mylabris ocellata* Pallas, 1773	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
11	*Mylabris quadripunctata* (Linnaeus, 1767)	*Bassia prostrata, Eutoria ceratoides, Haloxylon ammodendron*	flowers
12	*Mylabris tekkensis* Heyden, 1883	*Bassia prostrata*	flowers
Order - LEPIDOPTERA			
Family - Tortricidae			
1	*Phtheochroa subfumida* (Falkovitsh, 1963)	*Haloxylon ammodendron*	seeds
	Family - Orgyidae		
1	*Orgyia dubia* (Tauscher, 1806)	*Bassia prostrata, Eutoria ceratoides, Salsola orientalis, Haloxylon ammodendron*	generative organs, seeds

species belong to: Order Coleoptera: Species of the family Meloidae - *Mylabris amoenula, Mylabris calida, Mylabris maculata, Mylabris crocata, Mylabris elegantissima, Mylabris intermedia, Mylabris mannerheimi, Mylabris magnoguttata, Mylabris ocellata, Mylabris quadripunctata, Mylabris scabiosae, Mylabris tekkensis*. Species of the family Curculionidae - *Anthypurinus transversus, Baris memnonia, Phytonomus campestris*. Order Lepidoptera: species of the family Noctuidae - *Pseudohadena chenopodiphaga, Hadena ptochica, Scythocentropus scripturosa*; species of the family Orgyidae - *Orgyia dubia* and some monophagous species from the families Gelechiidae and Coleophoridae.

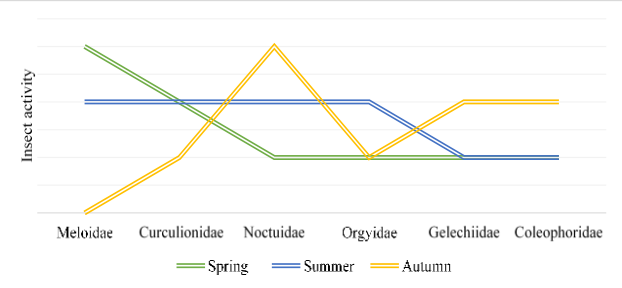

Fig. 4: Seasonal activity fluctuations of indirect pest insects

Their harmful effect is manifested in the destruction of the vegetative shoots and reproductive organs that fruit in spring and summer. This indirectly reduces the seed productivity of pasture plants. The graph shows that the Coleoptera family was most active in spring and summer. This indicates that these species are highly dependent on warm season conditions for their growth and reproduction. Their main activity coincides with the feeding and development of the generative organs of *Haloxylon ammodendron*, causing considerable damage to both reproductive structures and vegetative shoots. In autumn, the activity of most beetle species is lower. This decline is related to the completion of their life cycle and preparation for hibernation.

In autumn, the Noctuidae, Gelechiidae and Coleophoridae reach their peak of activity. These insects mainly damage the seeds of pasture plants, which reduces seed productivity and thus the food base for wild animals. Their absence in spring and summer indicates that they are biologically adapted to autumn conditions, when temperature and humidity are optimal for their development.

The free-living group consists mainly of polyphagous and oligophagous insects. These insects complete all stages of their development and feeding either on a single plant species or by damaging several plant species. Their development begins in spring and they remain active until late summer, passing through several generations. They feed on the sap of different plant organs, which slows down vegetative growth and reduces the quality of the generative organs, resulting in underdeveloped seeds with lower germination rates. The seasonal fluctuations in activity of the free-living group of insect pests are shown in Fig. 5. This group includes insects from the order Hemiptera: species of the family Dictyopharidae - *Chanithus pannonicus, Nymphorgerius plotnikovi, Sphenocratus* sp.; species of the family Cicadellidae - *Hardya turanica, Hardya imperator, Handianus eurotiae*. species of the family Coccoidea - *Atrococcus achilleae*, species of the family Aphidoidea - *Xerobion eriosomatinum, Xerobion camphorosmae, Xerobion cinae, Chaitaphis tenuicauda, Chaitaphis camphorosmae, Eichinaphis pamirica, Eichinaphis turanica, Brachycaudus eurotiae, Macrosiphoniella seriphidii, Macrosiphoniella terraealbae, Aphis craccivora*. Species of the family Miridae - *Deraeocoris punctulatus, Polymerus cognatus, Lygus gemellatus, Adelphocoris lineolatus, Phytocoris turkestanicus, Psallopsis kirgisicus, Solenoxyphus lepidus, Plagiognathus albipennis, Atomoscelis onustus*. Order Thysanoptera: Species of the family Phlaeothripidae - *Halothrips arthrophyte, Halothrips mordvilkoi*.

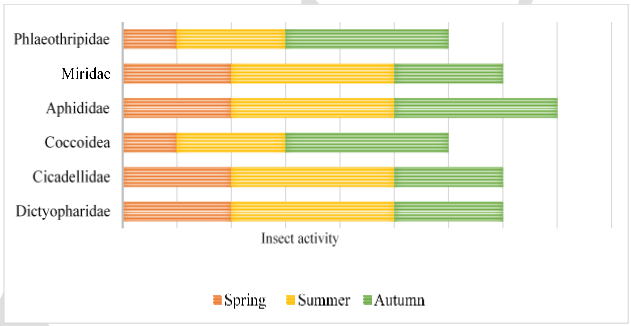

Fig. 5: Seasonal activity fluctuations of free-living group of pest insects

In spring, the activity of insect pests gradually increases, especially of species from the order Hemiptera, including families such as Dictyopharidae, Cicadellidae, Aphididae and Miridae. During this time, these insects begin to feed on the sap of young shoots, leaves and stems, which promotes their growth and reproduction. The first representatives of the Coccoidea also begin to appear, but their numbers remain low. In the Thysanoptera, the insects from the Phlaeothripidae family are just becoming active, but their impact on the plants is still minimal.

In summer, the number of all pest groups reaches its peak. Order Hemiptera, especially families: Cicadellidae, Aphididae and Miridae, actively feed on plant sap, weakening the plants and reducing their productivity. During this time, their populations grow rapidly, which can lead to widespread plant damage. The Coccoidea family becomes more numerous and begins to actively parasitise stems and leaves. The activity of the order Thysanoptera, especially the family Phlaeothripidae, also increases and causes damage to leaves and generative plant structures. In autumn, the activity of the Dictyopharidae and Cicadellidae gradually decreases as the conditions for reproduction become less favorable. However, the families: Aphididae, Coccoidea and Phlaeothripidae remain abundant as they continue to feed on seeds and dry plant stems. Aphid pests such as *Xerobion camphorosmae, Xerobion cinae, Xerobion eriosomatinum, Macrosiphoniella seriphidii* and *Macrosiphoniella terraealbae* can reach peak levels in autumn as they find new food sources. Coccoidea also reproduce actively during this time and cause

considerable plant damage. Phlaeothripidae remain active until temperatures drop due to their ability to feed on dry plant parts.

Hidden species, which are monophagous or oligophagous, develop in a particular way. The seasonal fluctuations in activity of the hidden group of insect pests are shown in Fig. 6. Their larvae and caterpillars go through all growth stages (except the adult stage) only on certain parts of their host plants. Their development is closely linked to the seasonal growth cycle of the plant. In spring and autumn, these insects feed on vegetative and generative plant organs as well as seeds, causing considerable damage. Main groups of hidden living pests: order Diptera, family Cecidomyiidae includes *Contarinia kochiae, Halodiplosis infestans, Halodiplosis inornata, Halodiplosis propria, Halodiplosis stakelbergi, Halodiplosis urceolatus, Halodiplosis vernalis, Halodiplosis vicina, Izeniola potanini, Janetiella gemmicola, Pseudokochiomyia vicina, Pseudokochiomyia mesasiatica, Pseudokochiomyia taranovii, Stefaniola camphorosmae*. Order Lepidoptera, species of the family Tortricidae - *Hysterosia subfumida, species of the family Coleophoridae - Casignetella gallivora, Coleophora magyarica, Coleophora polynella, Aporiptura keireuki, Aporiptura hypomona, Aporiptura macilenta, Aureliana psamata, Carpochena ceratoidis, Carpochena dilabens, Carpochena echinacea, Casignetella arenifera, Characia haloxyli, Coleophora caroxyli, Coleophora cyrta, Coleophora psamata, Coleophora schinacea, Ecebalia psammodes, Ecebalia tecta, Ecebalia tornata, Ecebalia villosa, Ionescumia izenella, Ionescumia sacsauli, Ionescumia pagodella, Tritemachia captiosa. Species of the family Gelechiidae - Euscrobipalpa alterna, Gelechia sp., Scrobipalpa* sp.1, family Pyralidae - *Thospia permixtella*, family Geometridae - *Eupithecia exactata, family Noctuidae - Cardepia irrisoria, Pseudohadena chenopodiphaga, Hadena ptochica, Scythocentropus scripturosa*. This group is categorized according to their way of life and diet: Gall-forming insects (Cecidomyiidae), case-bearing insects (Coleophoridae) and tissue-feeding insects (Gelechiidae, Pyralidae). Depending on their seasonal development, they are divided into spring-autumn and autumn species. In spring, for example, the first generation of Cecidomyiidae (*Pseudokochiomyia vicina, Pseudokochiomyia mesasiatica, Pseudokochiomyia taranovii, Halodiplosis vicina, Halodiplosis propria, Halodiplosis infestans, Halodiplosis vernalis, Halodiplosis inornata, Halodiplosis stakelbergi*) damages seedlings and vegetative shoots. The second generation attacks the generative organs and seeds of *Haloxylon ammodendron* and *Bassia prostrata*. Most Cecidomyiidae develop in two generations per year, while some Coleophoridae moths complete their cycle in only one generation.

In general, insect pests that damage the reproductive organs and seeds of pasture plants can affect the overall productivity of pasture, but their impact is not always significant. Some species, however, cause periodic population outbreaks in different plant communities that cause noticeable damage. Of the species recorded, the following are found in large numbers each year on Haloxylon ammodendron: Family Cecidomyiidae - *Halodiplosis infestans, Halodiplosis propria*; Family Tortricidae - *Casignetella gallivora, Casignetella caroxyli;* Family Gelechiidae - Scrobipalpa sp.1; Family Orgyidae - Orgyia dubia; Family Noctuidae - *Cardepia irrisor*. On Eurotia ceratoides: family Coleophoridae - *Carpochena ceratoidis, Carpochena echinacea*; family Cecidomyiidae - *Janetiella gemmicola*. On *Bassia prostrata*: Family Cecidomyiidae - *Pseudokochiomyia mesasiatica, Pseudokochiomyia taranovii*; Family Coleophoridae - Aureliana tecta; Family Gelechiidae - Gelechia sp.1; Family Curculionidae - *Metadonus campesrtis*. On *Artemisia terrae-albae*: family Cecidomyiidae - *Rhopalomyia baudysi*, family Coleophoridae - *Casignetella arenifera, Coleophora polynella*. On Salsola orientalis: family Coleophoridae - *Coleophora dilabens, Ionescumia pagodella, Ecebalia psammodes*; family Cecidomyiidae - *Halodiplosis propria*; family Pyralidae - *Thospia permixtella*.

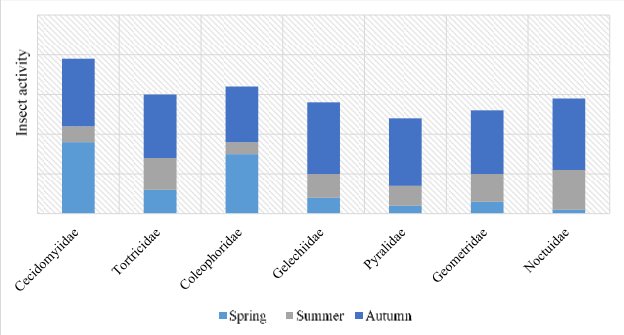

Fig. 6: Seasonal activity fluctuations of hidden-living group of pest insects.

DISCUSSION

The aim of this study was to identify and characterise insect pests infesting the seeds and reproductive organs of Haloxylon ammodendron and important pasture plants in south-eastern Kazakhstan. Our results provide a comprehensive overview of the species composition of these pests and their impact on seed quality and germination of key pasture plants, including Haloxylon ammodendron, Bassia prostrata, Artemisia terrae-albae, Eurotia ceratoides, Salsola orientalis and Camphorosma songorica. The results showed that 96 pest species belonging to 5 orders and 16 families negatively affect the reproductive structures of these plants. This emphasises the considerable taxonomic diversity of insect pests associated with pasture ecosystems and their role in reducing seed viability and limiting plant regeneration.

Recent studies across Central Asia confirm our findings on the diversity of insect pests and their impact on seeds. For example, studies in the Khorezm region of Uzbekistan have identified various Miridae (Hemiptera) that infest crops such as cotton and alfalfa, feeding on the reproductive organs and reducing yields (Sadullaevich et al., 2022). The discovery of Halyomorpha halys (brown marmorated stink bug) in Uzbekistan also emphasises the threat to agricultural crops due to its feeding habits on seeds and fruits (Gandjaeva et al., 2023). Akulov et al. (2018) documented 125 Microlepidoptera species from 22 families in the southern regions of the Krasnoyarsk

Territory and the Republic of Khakassia, with the families Gelechiidae and Gracillariidae accounting for almost half of the identified species. Their studies emphasise the impact of monophagous and oligophagous insects, especially Coleophoridae and Gelechiidae, on seed yield and germination rates. Similarly, Kirichenko et al. (2019) used DNA barcoding to investigate the diversity and host-plant associations of leaf-mining micromoths (Gracillariidae) in the Russian Far East, revealing intricate insect–plant interactions and identifying potential new species.

When we compare our results with previous studies, we find similarities in the composition and impact of the pests. However, our study expands the understanding of insect species associated with desert ecosystems. An important finding is that most pests belong to the Hemiptera, confirming previous research by Schwertner et al. (2021), who identified this group as dominant among pests of seeds and reproductive organs. Our study also identified previously unrecorded species such as Chanithus pannonicus and Nymphorgerius plotnikovi (family Dictyopharidae), emphasising the importance of continuous monitoring of pest species on pastures and agricultural land. Further research has emphasised the dominance of Hemiptera pests in damaging seeds and reproductive organs (Souza et al. 2024). Species such as Aphis craccivora and Sphenocratus sp. are common in arid ecosystems and significantly affect seed productivity when populations reach high densities. Allayarov (2021) also found that Pseudococcidae insects cause significant damage to Artemisia terrae-albae and other pasture plants, reducing seed germination and the overall regenerative capacity of the pasture.

Our results are consistent with recent global studies that show seasonal variations in insect pest activity. Spring and summer mark the main periods of activity for indirect feeders such as beetles, weevils and moths, which coincide with plant growth phases and increase damage to reproductive organs (Stankevych et al., 2020). Free-living insects, including Hemiptera and Thysanoptera, also show high activity during this period, although their impact varies depending on food preference. While their activity decreases in autumn, they continue to affect seed quality and germination rates, reducing available forage for livestock (Ouaarous et al., 2025). Hiding pests such as Cecidomyiidae are active in both spring and autumn, feeding on plant tissue and causing long-term damage to generative organs (Bernardo et al., 2021).

Recent studies have emphasised the role of Lepidoptera pests in seed predation. For example, studies by Albu et al. (2023) in desert ecosystems have shown that Coleophoridae, Gelechiidae, Pyralidae and Noctuidae species are more active in autumn and cause extensive seed damage. Their work suggests that this seasonal pest peak significantly reduces seed productivity, emphasising the urgent need for targeted pest control strategies. Furthermore, climate change has been shown to influence the occurrence of pests by shifting their phenology and extending their activity periods, exacerbating their impact on pasture ecosystems (Horgan, 2020). Overall, our results contribute to the growing body of research on insect pests in arid and semi-arid regions. They emphasise the need for continuous monitoring, especially in light of climate-induced shifts in pest dynamics. Effective pest management strategies should take into account seasonal activity trends and emerging threats from newly recorded species to ensure the sustainability of pasture ecosystems. Future research should explore integrated pest management approaches tailored to desert environments, incorporating biological control methods and climate-adapted strategies to mitigate the impact of seed-feeding pests.

Conclusion

In this study, a list of insect pests damaging the generative organs and seeds of saxaul (*Haloxylon ammodendron*) and pasture plants in the deserts of southeastern Kazakhstan was compiled. A total of 96 phytophagous insect species belonging to 5 orders and 16 families were identified. Species from the orders Homoptera, Thysanoptera, Coleoptera, Diptera and Lepidoptera had the greatest influence on seed productivity. An analysis of their food preferences showed that monophagous species (45 in total) dominate, indicating their high adaptation to certain plant species. Oligophagous species (25 in total) target important pasture plants and impair the natural regeneration of plant communities. Polyphagous species (26 in total) have a broad food spectrum and can damage various plant species, which reduces their reproductive potential. Particular attention should be paid to phytophagous insects that damage seeds and generative organs, as they significantly limit the natural reproduction of plant communities - a especially critical issue for arid ecosystems. The identified patterns of food specialisation of pests can be used to develop strategies for the protection and restoration of pasture ecosystems and for the management of pest populations based on their biological characteristics.

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REFERENCES

Abukenova, V.S., Slavchenko, N.P., Kartbayeva, G.T., Myrzabayev, A.B., Yeshmagambetova, A.B., Duzbayeva, N.M., Kabbassova, M.T., & Abukenova, A.K. (2022). Composition and ecological structure of the fauna of litter and soil true bugs (Insecta, Heteroptera) in Kazakh Upland (Central Kazakhstan) pine forests. *Diversity, 14*(8), 618. https://doi.org/10.3390/d14080618

Akulov, E.N., Kirichenko, N.I., & Ponomarenko, M.G. (2018). Contribution to the Microlepidoptera fauna of the South of Krasnoyarsk Territory and the Republic of Khakassia. *Entomological Review, 98*, 49–75. https://doi.org/10.1134/S001387381801001X

Albu, V., & Albu, S. (2023). Lepidoptera assemblages along a western slope elevation gradient of the South-Central Sierra Nevada Mountains in California. *The Journal of the Lepidopterists' Society, 77*(1), 43–58. https://doi.org/10.18473/lepi.77i1.a3

Allayarov, S. (2021). Importance of pasture plant protection measures and involvement of local communities in them. In *Proceedings from the International Cold Winter Desert Conference* (pp. 209–215). https://doi.org/10.4060/cc1339en

Azhbenov, V., Shamuratov, D., Niyazbekov, Z., Dinassilov, A., Arystangulov, S., Baibussenov, K., Bashkarayev, N., & Zhumagaliyev, A. (2024). Localized biopesticide application using UAVs for the control of migratory locusts in Kazakhstan. *Organic Farming, 10*(3), 175–184. https://doi.org/10.56578/of100302

Baibussenov, K., et al. (2021). Investigation of factors influencing the reproduction of non-gregarious locust pests in northern Kazakhstan to substantiate the forecast of their number and planning of protective measures. *OnLine Journal of Biological Sciences, 21*(1), 144–153. https://doi.org/10.3844/ojbsci.2021.144.153

Bernardo, U., Nugnes, F., Gargiulo, S., Nicoletti, R., Becchimanzi, A., Stinca, A., & Viggiani, G. (2021). An integrative study on *Asphondylia* spp. (Diptera: Cecidomyiidae), causing flower galls on Lamiaceae, with description, phenology, and associated fungi of two new species. *Insects, 12*(11), 958. https://doi.org/10.3390/insects12110958

Bolatova, Z. (2023). Climate change impact on agriculture of Almaty Region, Kazakhstan. In S. Haddout, P. K. Lakshmi, & A. M. Hoguane (Eds.), *Climate change and ocean renewable energy* (pp. 189–203). Springer. https://doi.org/10.1007/978-3-031-26967-7_12

Gandjaeva, L., Abdullaev, I., Iskandarov, A., Allabergenova, K., Yusupova, S., Narimanova, G., Yusupboev, E., Ibragimova, S., Begliev, S., & Bobojonova, K. (2023). A zoogeographical analysis of true bugs (Insecta, Heteroptera) from Uzbekistan. *ZooKeys*, *1163*, 121–142. https://doi.org/10.3897/zookeys.1163.99414

González-Chang, M., Tiwari, S., Sharma, S., & Wratten, S.D. (2019). Habitat Management for Pest Management: Limitations and Prospects. *Annals of the Entomological Society of America*, *112*(4), 302–317. https://doi.org/10.1093/aesa/saz020

Horgan, F.G. (2020). Potential for an impact of global climate change on insect herbivory in cereal crops. In *Crop protection under changing climate* (Vol. 2, pp. 101–144). Springer. https://doi.org/10.1007/978-3-030-46111-9_5

Kadyrbekov, R.K. (2024). *Adenophoraphis*, a new aphid genus from Kazakhstan (Hemiptera: Aphididae: Macrosiphini). *Bulletin of the Karaganda University: Biology, Medicine, Geography Series, 11529*(3), 45–50. https://doi.org/10.31489/2024bmg3/45-50

Kansman, J., Nalam, V., Nachappa, P., & Finke, D.L. (2020). Plant water stress intensity mediates aphid host choice and feeding behavior. *Ecological Entomology, 45*(6), 1437–1444. https://doi.org/10.1111/een.12928

Kirichenko, N.I., Akulov, E.N., Babichev, N.S., Mikhailova, I.A., Ponomarenko, M.G., & Lopez-Vaamonde, C. (2019). Past distribution of *Tilia*-feeding *Phyllonorycter* micromoth (Lepidoptera: Gracillariidae) in the Russian Far East based on survey of historical herbarium. *Far Eastern Entomologist, 390*, 19–32. https://doi.org/10.25221/fee.390.3

Maity, A., Paul, D., Lamichaney, A., Sarkar, A., Babbar, N., Mandal, N., Dutta, S., Maity, P.P., & Chakrabarty, S.K. (2023). Climate change impacts on seed production and quality: Current knowledge, implications, and mitigation strategies. *Seed Science and Technology, 51*(1), 7–38. https://doi.org/10.15258/sst.2023.51.1.07

Malhi, Y., Franklin, J., Seddon, N., Solan, M., Turner, M.G., Field, C.B., & Knowlton, N. (2020). Climate change and ecosystems: Threats, opportunities and solutions. *Philosophical Transactions of the Royal Society B: Biological Sciences, 375*(1794), 20190104. https://doi.org/10.1098/rstb.2019.0104

Mombayeva, B.K., Taranov, B.T., & Harizanova, V. (2024). Biological and ecological features of coleophoridae pests feeding on saxaul. *Ġylym žăne bilim, 2*(75), 153–161. https://doi.org/10.52578/2305-9397-2024-2-2-153-161

Montgomery, G.A., Belitz, M.W., Guralnick, R.P., & Tingley, M.W. (2021). Standards and best practices for monitoring and benchmarking insects. *Frontiers in Ecology and Evolution, 8*, 579193. https://doi.org/10.3389/fevo.2020.579193

Mordkovich, V.G., Khudyaev, S.A., Dudko, R.Y., & Lyubechanskii, I.I. (2020). Zoological indication of climate change in the Central Kazakh Steppe. *Contemporary Problems of Ecology, 13*(5), 443–468. https://doi.org/10.1134/S1995425520050078

MUK 4.2.1479-03 (2021). *Entomological methods of collecting and determining insects and pest mites of food stocks and non-food raw materials*. https://meganorm.ru/Data2/1/4293756/4293756612.pdf

Muluneh, M.G. (2021). Impact of climate change on biodiversity and food security: A global perspective—a review article. *Agriculture & Food Security, 10*(1), 1–25. https://doi.org/10.1186/s40066-021-00318-5

Nasiyev, B., Shibaikin, V., Bekkaliyev, A., Zhanatalapov, N.Z., & Bekkaliyeva, A. (2022). Changes in the quality of vegetation cover and soil of pastures in semi-deserts of West Kazakhstan, depending on the grazing methods. *Journal of Ecological Engineering, 23*(10), 50–60. https://doi.org/10.12911/22998993/152313

Nyrmyratov, T.N. (1997). *Ekologıcheskıe osnovy zaıty pastbı pystyn ıygo-vostochnogo Kazahstana ot vrednyh nasekomyh i gryzýnov* [Dissertation work]. http://www.dslib.net/fito-patologia/jekologicheskie-osnovy-zawity-pastbiw-pustyn-jugo-vostochnogo-kazahstana-ot-vrednyh.html

Ouaarous, M., El Fakhouri, K., Taarji, N., Baouchi, A., Amri, M., Ramdani, C., Sobeh, M., Mesfioui, A., & El Bouhssini, M. (2025). Impact of field insect pests on seed and nutritional quality of some important crops: A comprehensive review. *ACS Omega, 10*(9), 8779–8792. https://doi.org/10.1021/acsomega.4c08982

Kazakhstan Research Institute of Plant Protection and Quarantine PPQI (2023). *Integrated pest management strategies for desert pastures*. https://www.niizkr.kz/metodicheskie-ukazaniya-i-rekomendaczii/?utm_source=chatgpt.com

Robinson, S., Bozayeva, Z., Mukhamedova, N., Djanibekov, N., & Petrick, M. (2021). Ranchers or pastoralists? Farm size, specialisation and production strategy amongst cattle farmers in south-eastern Kazakhstan. *Pastoralism, 11*(1), Article 31. https://doi.org/10.1186/s13570-021-00217-1

Sadullaevich, B.A., Mirganievna, M.M., Bazar ugli, T.M., Shukururilla kizi, A. D., & Kamoliddin Kizi, M.R. (2022). Fauna and plant nutrition of bed-bugs belonging to the family of Mirid (Miridae) found in cotton, alfalfa, vegetable agrocenoses and natural ecosystems of the Amudarya and Khodjayli districts of the Republic of Karakalpakstan. *European Journal of Agricultural and Rural Education, 3*(2), 69–74.

Salnikov, V., Talanov, Y., Polyakova, S., & Assylbekova, A. (2023). An assessment of the present trends in temperature and precipitation extremes in Kazakhstan. *Climate, 11*(2), 33. https://doi.org/10.3390/cli11020033

Schwertner, C.F., Carrenho, R., Moreira, F.F.F., & Cassis, G. (2021). Hemiptera sampling methods. In J. C. Santos & G. W. Fernandes (Eds.), *Measuring arthropod biodiversity* (pp. 289–313). https://doi.org/10.1007/978-3-030-53226-0_12

Skendžić, S., Zovko, M., Živković, I.P., Lešić, V., & Lemić, D. (2021). The impact of climate change on agricultural insect pests. *Insects, 12*(5), 440. https://doi.org/10.3390/insects12050440

Souza, E.A., do Val, R.M.M., Lisboa, L.C.O., & Serrão, J.E. (2024). Morphology of the female receptaculum seminis of *Euschistus heros* (Fabricius, 1798) (Insecta: Hemiptera: Pentatomidae). *Anais da Academia Brasileira de Ciências, 96*(4), e20230705. https://doi.org/10.1590/0001-3765202420230705

Sreedevi, K., Sree Chandana, P., Correya, J.C., Shashank, P.R., Singh, S., &

Veenakumari, K. (2022). Economically important wood feeding insects: Their diversity, damage and diagnostics. In R. Sundararaj (Ed.), *Science of wood degradation and its protection* (pp. 115–145). Springer Singapore. https://doi.org/10.1007/978-981-16-8797-6_4

Sridhar, J.K., Kiran Kumar, R.K., Murali-Baskaran, R.K., Senthil-Nathan, S., Sharma, S., Nagesh, M., Kaushal, P., & Kumar, J. (2020). Impact of climate change on communities, response and migration of insects, nematodes, vectors and natural enemies in diverse ecosystems. In P. S. Minhas, J. K. Sridhar, & R. K. Kiran Kumar (Eds.), *Global climate change: Resilient and smart agriculture* (pp. 69–93). Springer. https://doi.org/10.1007/978-981-32-9856-9_4

Stankevych, S.V., Biletskyj, Y.M., Zabrodina, I.V., Yevtushenko, M.D., Dolya, M.M., Lezhenina, I.P., Baidyk, H.V., Filatov, M.O., Sirous, L.A., Melenti, V.O., Molchanova, O.A., Zhukova, L.V., Golovan, L.V., Polozhenets, V.M., Nemerytska, L.V., & Klymenko, I.V. (2020). Cycle populations dynamics of harmful insects. *Ukrainian Journal of Ecology, 10*(3), 147–161. https://doi.org/10.15421/2020_148

Tumenbayeva, N.T., Taranov, B.T., Grekov, D., & Harizanova, V.B. (2016). Lepidopteran species (Insecta: Lepidoptera) feeding on saxauls (Amaranthaceae) in desert areas of South-Eastern Kazakhstan. *Agricultural Sciences, 3*(19), 69–74. http://agrarninauki.au-plovdiv.bg/wp-content/uploads/2019/01/Agrarni-Nauki_19_2016_10.pdf

Vilela, A.E., González-Paleo, L., Ravetta, D.A., Murrell, E.G., & Van Tassel, D.L. (2020). Balancing forage production, seed yield, and pest management in the perennial sunflower *Silphium integrifolium* (Asteraceae). *Agronomy, 10*(10), 1471. https://doi.org/10.3390/agronomy10101471

Yatsyuk, S., Turganbayev, T., Sadykov, B., & Baibussenov, K. (2020). Features of spread and harmfulness of wheat thrips (*Haplothrips tritici* Kurd.) on spring wheat crops and protective measures. *Trends in the Development of Science and Education, 66*(1), 81–88. https://doi.org/10.18411/lj-10-2020-21

Yerkin, A., Lei, J., Wang, Y., Mazbayev, O., Myrzaliyeva, Z.K., & Tazhekova, A.Z. (2022). Analysis of the distribution and formation of desertification processes in Kazakhstan and measures for prevention. *Journal of Geography & Environmental Management, 67*(4), 126. https://doi.org/10.26577/JGEM.2022.v67.i4.10

Zafar, M.M., Razzaq, A., Anwar, Z., Ijaz, A., Zahid, M., Iqbal, M.S., & Jiang, X. (2025). Enhancing salt tolerance and yield potential in cotton: insights from physiological responses, genetic variability, and heterosis. *Turkish Journal of Agriculture and Forestry*, *49*(1), 110-124. https://doi.org/10.55730/1300-011X.3252

Zafar, M.M., Razzaq, A., Farooq, M.A., Rehman, A., Firdous, H., Shakeel, A., Mo, H., & Ren, M. (2020). Insect resistance management in Bacillus thuringiensis cotton by MGPS (multiple genes pyramiding and silencing). *Journal of Cotton Research*, *3*(1). https://doi.org/10.1186/s42397-020-00074-0