LEPIDOPTERAN SPECIES (*INSECTA: LEPIDOPTERA*) FEEDING ON SAXAULS (*AMARANTHACEAE*) IN DESERT AREAS OF SOUTH-EASTERN KAZAKHSTAN

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Abstract

In Kazakhstan saxaul plays an important role in maintaining the balance of the desert ecosystems, which represent a considerable part of the country. Due to their extensive root system, saxaul plants prevent desert areas from shifting sands. Nowadays the area of naturally occurring saxauls is seriously limited under the influence of anthropogenic and some biotic factors.

Insects feeding on leaves, flowers, seeds, tunneling the stems, shoots and roots cause changes in its growth and development and influence the life span. In 2013–2014 a total of 34 species belonging to 13 *Lepidoptera* families were found to damage saxauls in the desert zone of South-Eastern Kazakhstan, Almaty region, Balkash and Jambul, the region of Moinkum.

Key words: saxaul, insect pests, *Lepidoptera*, species composition.

INTRODUCTION

One of the major goals of modern world is preservation of biodiversity. Related to this a number of international and national strategies for preservation of rare and threatened of extinction species in the flora and fauna *in situ* and *ex situ* are being developed. Woodlands of Kazakhstan constitute 4% of the entire territory of the country. Of them 2% are saxauls. Priority directions have been developed in the National Action plan for preservation of biodiversity of Kazakhstan.

There are two species of saxaul in Kazakhstan: black saxaul (*Haloxylon ammodendron* (C.A.Mey) Bunge - (Synonym: *Haloxylon aphyllum* (Minkw.) Jljin. And *white saxaul* (*H. persicum* Bunge ex Boiss & Buhse). Their area of distribution coincides with the margins of the deserts of the temperate zone of Eastern, Central, and Western Asia. Saxauls are salty-soil desert plants, shrubs or trees, up to 12 m tall. May occur alone or in mixed strands. Saxaul plays great role in maintaining the balance in the desert ecosystems, which are considerable part of Kazakhstan. Due to its extensive root system it prevents the invasion of the desert sands. The territories occupied by saxaul nowadays are being seriously reduced under the influence of anthropogenic and other factors. Limitation of further reduction of the territories could be achieved by cultivation of saxaul as a crop. Survival rate of plants in these cultivated plantations is very low.

There are a lot of pests of saxauls in the region of its present distribution, the damage and economic importance of which, have been described and evaluated (Parfentev, 1958). The saxaul longhorn beetle, *Turcmenigena varentzovi* Melgunov is able to kill infested trees either itself or in association with a cossid *Holcocera campiola* or saxaul buprestids of the genus Shperoptera (Plavilshchikov, 1940; Marikovskii, 1955; Maslov, 1988). The saxaul locust *Derycoris albidula* (Orthoptera: Dericorythidae) is a major pest of saxaul plants in Iran, causing severe damage in different growth periods (Adeli and Abaei,1989; Moniri, 1998). In Guerbantonggute desert in China where *Haloxylon persicum* is the main plant, Xue et al. (2006) described a new species from Lepidoptera (Geometridae): *Desertobia heloxylonia* Xue, sp. nov., which is seriosly damaging saxaul plants (XUE Da- Yong et al., 2006). Three pest species are mentioned in a study of Shamzadeh & Baghestani (2003) damaging saxauls in Algeria: a jumping plant lice *Caillarida inedita* (Homoptera: Psyllidae), *Achrus taghizadahi* (Homoptera: Cicadellidae) and a moth *Proceratia caesariella* (Lepidoptera: Pyralidae).

According to previous reports of Nurmuratov (Nurmuratov, 1970; Nurmuratov, 1970a; Nurmuratov, 1971; Nurmuratov, 1979) last century in the pastures with saxauls there were cases of very high population density of lepidopteran pests, like leafroller moths, owlet moths, grasshoppers, gall midges, psyllids, etc. Such species damaged saxaul plants

and almost destroyed their populations on vast territories. In 1967 the average population density of the moth *Pseudohodena immunda* Ev. on the pastures of Betpakdala desert reached up to 124 larvae/m^2 on an area of 500 000 ha (Nurmuratov, 1973). In the Ili desert in 1969 a high population density of the larvae of another moth (*Pzeudohodena immunda* Ev) has been recorded on area of 50 000 ha. On a single tree (shrub) 90 cm tall 162 larvae have been counted, and on others – from 45 to 118 (Nurmuratov, 1973).

All kind of transformations taking place in the environment of wildlife, including insects, cause changes in their species composition, distribution, population density and harmul activity, eventually are changing their role and impact in ecosystems. Having in mind the negative impact of anthropogenic factors on Kazakhstan's fauna, low level of nature protecting activities, insufficient knowledge about lepidopteran fauna, a prediction could be maid that without intensive research and actions for protection, more than half of the plant species will dissapear until the 3-decade of 21 century with all the related negative consequences (Taranov, 2011).

Insects, as one of the most important biotic factors, have a significant impact on seed germination and survival of young seedling of cultivated saxauls and at any of its phenological stages. Insect species, feeding on leaves, flowers, seeds, tunneling the stems, shoots and roots cause changes in its development and influence the life span.

Lepidopteran entomofauna on saxaul plants is composed of many polyphagous and oligophagous species, damaging roots, vegetative and generative plant organs. In spring first-year plantations are heavily damaged by polyphagous pests which cause decrease in survival rate of seedlings and young plants.

These facts require further research on the entomofauna on saxaul plants, including from Lepidoptera, found in the desert zone of South-Eastern Kazakhstan.

MATERIALS AND METHODS

For field collection of insects standard entomological methods have been used (Fasulati, 1971, etc.) with some modifications. For evaluation of the population density of the lepidopteran species at the different sites in respect to ecological groups and insect developmental stages, the methods used were developed by Yahontov (1969), Gilyarov (1975), etc. For monitoring of the species these methods were unified. Light traps were used for collection of nocturnal species, placed periodically at the same sites or as close as possible to the previous collection site. Samples were taken at fixed intervals in order to get data about the biology of the species (number of generations, stage, etc.). The light provided by the light trap was with the same wave length during the entire monitoring period. Intervals between sampling were chosen depending on the season and time of day.

Barber pitfall traps – plastic caps with fixing liquid, were placed in the collection sites using a definite scheme. Time of exposition depended on the condition of the biotope, weather conditions and season.

RESULTS AND DISCUSSION

As a result of the current study in the desert zone of South-Eastern Kazakhstan, Almaty region, Balkash and Jambul region of Moinkum, a total of 34 lepidopteran species were identified (Table 1).

Among the species from Lepidoptera feeding on vegetative organs of saxaul the most damaging are those from Noctuidae, Scythrididae and Geometridae.

On seeds, flowers and shoots four species were found to feed: from Noctuidae, Pyralidae, Tortricidae and Erebidae. The adult of most of the pests is feeding complementary on flower nectar.

Twenty seven species are feeding on the vegetative organs, four - on the generative organs, four species are feeding on both vegetative and generative organs, and 2 species are damaging the roots (Table 1). Some of the lepidopteran families are presented by only one species. According to us, the number of lepidopteran species – pests of saxauls is much greater.

Species, influencing the growth of saxaul plants were divided to the following ecological groups: commonly found and constantly damaging species; complex of species with low population density, but capable of rapid mass reproduction; specialized species, dwelling on only one plant.

Regarding the host specificity, 12 of the pests are narrow olygophagous, 7 are broad olygophagous, 2 are olygophagous, 11 are polyphagous and 2 are monophagous, feeding only on saxauls (Table 1).

Regarding the seasonal occurrence the lepidopteran pests found on saxaul plans were divided to spring, summer, and autumn species:

- spring occurring species (14): *Holcocerus campiocola* and *H. inspersus* (Cossidae)*; Coleophora haloxyli* (Coleophoridae); *Scythris cirra* and *Scythris haloxylella* (Scythrididae); *Scrobipalpa sp.* (Gelechiidae); *Anoristia atrisparsella* (Pyralidae); *Celerio lineata* (Sphingidae); *Zygaena truchmena* (Zygaenidae); *Paraphtorarcha kasachstanika* (Geometridae); *Caradrina albina, Athetis quadripunctata, Diadochia esurialis,* and *Pseudopseustis striolata* (Noctuidae).

Table 1. Species composition of insect pests (Lepidoptera) damaging saxaul (*Haloxylon* spp.) in the desert zone of South-Eastern Kazakhstan

N	Family/Species	Host plant	Organothrophic specialization	Host specificity
	Cossidae			
1	*Holcocerus campiocola* (Eversmann, 1854)	*Haloxylon* spp.	root, stem	narrow olygophagous
2	*Holcocerus inspersus* Christoph, 1887	*Haloxylon* spp.	root	narrow olygophagous
	Tortricidae			
3	*Phtheochroa subfumida* (Falkovitsch, 1963)	*Haloxylon* spp.	seeds	polyphagous
	Coleophoridae			
4	*Coleophora haloxyli* Falkovitsh,1972	*Haloxylon* spp.	shoots	narrow olygophagous
5	*Casignetella gallivora* (Falkovitsh, 1970)	*Haloxylon* spp.	stem	monophagous
	Scythrididae			
6	*Scythris cirra* Falkovitsh, 1969	*Haloxylon* spp.	shoots	narrow olygophagous
7	*Scythris haloxylella* Falkovich, 1969	*Haloxylon* spp.	shoots	broad olygophagous
	Gelechiidae			
8	*Scrobipalpa* sp.	*Haloxylon* spp.	leaves	monophagous
	Pyralidae			
9	*Anoristia atrisparsella* Ragonot, 1887	*Haloxylon* spp.	shoots	broad olygophagous
10	Species not identified 1	*Haloxylon* spp.	seeds	narrow olygophagous
11	Species not identified 2	*Haloxylon* spp.	seeds	narrow olygophagous
	Sphingidae			
12	*Celerio lineata livornica Esp*.	*Haloxylon* spp.	shoots	polyphagous
	Zygaenidae			
13	*Zygaena truchmena* Eversmann, 1854	*Haloxylon* spp.	shoots	broad olygophagous
	Geometridae			
14	*Paraphtorarcha kasachstanika* Stsh.	*Haloxylon* spp.	shoots	narrow olygophagous
	Lasiocampidae			
15	*Lasiocampa eversmanni* (Eversmann, 1843)	*Kochia prostrata*, *Haloxylon* spp.	shoots, leaves	polyphagous
	Noctuidae			
16	*Euxoa conspicua* (Hubner, 1825)	*Kochia prostrata*, *Haloxylon* spp.	shoots, leaves	polyphagous
17	*Cardepia irrisor* (Erschoff,1874)	*Haloxylon* spp.	shoots, seeds	broad olygophagous
18	*Hadula ptochica* (Püngeler, 1899)	*Haloxylon* spp.	shoots, seeds	narrow olygophagous
19	*Thargelia fissilis* Christoph 1884	*Haloxylon* spp.	leaves, shoots	broad olygophagous
20	*Thargelia sitiens* Püngeler 1914	*Haloxylon* spp.	leaves, shoots	narrow olygophagous
21	*Thargelia distincta* Cristoph, 1884	*Haloxylon* spp.	leaves	olygophagous
22	*Pseudohadena chenopodiphaga* (Rambur, 1832)	*Haloxylon* spp.	shoots, seeds	narrow olygophagous
23	*Pseudohadena immunda Eversmann, 1842*	*Haloxylon* spp.	leaves, shoots	polyphagous
24	*Pseudohadena immunis* Staudinger, 1889	*Haloxylon* spp.	leaves, shoots	polyphagous
25	*Pseudohadena siri* Erschoff, 1874	*Haloxylon* spp.	leaves, shoots	broad olygophagous
26	*Caradrina albina* Eversmann, 1848	*Haloxylon* spp.	shoots	polyphagous
27	*Athetis quadripunctata* Fabricius, 1775	*Haloxylon* spp.	shoots	polyphagous
28	*Diadochia esurialis* Pungeler 1914	*Haloxylon* spp.	shoots	broad olygophagous
29	*Pseudopseustis elinguis* (Püngeler, 1914)	*Haloxylon* spp.	leaves	narrow olygophagous
30	*Pseudopseustis striolata* (Filipjev, 1949)	*Haloxylon* spp.	shoots	olygophagous
31	*Scythocentropus scripturosa* (Eversmann 1854)	*Haloxylon* spp.	seeds	narrow olygophagous
	Erebidae			
32	*Lacydes spectabilis* (Tauscher, 1806)	*Haloxylon* spp. *Ceratoides* spp.	shoots, leaves	polyphagous
33	*Tancrea pardalina* Püngeler, 1898	*Haloxylon* spp.	shoots, leaves	polyphagous
34	*Orgyia dubia* (Tauscher, 1806)	*Haloxylon* spp. *Ceratoides* spp. *Kochia prostrata*	shoots, leaves, seeds	polyphagous

Fig. 1. *Larva of Orgyia dubia Tausch. on saxaul (Noctuidae*)

- summer occurring species (14): *Casignetella gallivora* (Coleophoridae); *Lasiocampa eversmanni* (Lasiocampidae); *Euxoa conspicua, Thargelia fissilis, T. sitiens, Pseudopseustis elinguis, Thargelia distincta, Pseudohadena immunda, P. immunnis, P. siri* and *P. Chenopodiphaga* (Noctuidae); *Lacydes spectabilis, Tancrea pardalina* and *Orgyia dubia* (Erabidae).

- autumn occurring species (7): *Phtheochroa subfumida* (Tortricidae); unidentified species 1 and 2 (Pyralidae); *Cardepia irrisor, Hadula ptochica*, *Scythocentropus scripturosa* (Noctuidae).

Our study revealed that in nurseries for cultivation first year plantations of saxaul in spring are most heavily damaged by polyphagous pests, like *Euxoa conspicua,* causing reduced survival of seedlings and retarded growth of young plants. Saxaul plants are damaged mainly by polyphagous species (Noctuidae), feeding on the shoots; olygophagous, feeding on shoots; specialized carpophagous, feeding on generative organs. In the seed samples there were specialized species from families Cecidomyiidae and Coleophoridae. It was estimated that the damage caused by feeding of insects on saxaul may reach 20 to 80% (*Coleophoridae*). Several species are feeding on leaves, stems and shoots.

CONCLUSIONS

1. Species from Lepidoptera represent the most important insect group in deserts, having the greatest biological diversity. As a result of the study in the desert zone of South-East Kazahkstan a total of 34 species were identified to feed on saxaul.

2. For the specialized species, peculiarities in phenology and annual life cycles are reflection of their adaptability to saxaul plants.

3. Among the studied species, most are commonly found on saxauls by the beginning of summer.

4. During the hot summer months the number of flying lepidopteran adults rapidly decreases, the development of many is interrupted and the flight is resumed in autumn. In autumn there is an increase in the number of species and their population density.

5. Organothrophic specialization of the identified species feeding on saxauls was established. A total of 27 species are feeding on vegetative organs, 4 – with generative organs, 4 - both with vegetative and generative organs and 2 – with roots.

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