Vestnik zoologii, **44**(2): 167–171, 2010

UDC 595.42(477)

NEW DATA ON SUCCESSFUL INVASION OF MEDITERRANEAN PREDATORY MITE *TYPHLODROMUS BEGLAROVI* (PARASITIFORMES, PHYTOSEIIDAE) INTO THE FOREST-STEPPE OF UKRAINE

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Received 14 July 2009
Accepted 8 February 2010

New Data on Successful Invasion of Mediterranean Predatory Mite *Typhlodromus beglarovi* (Parasitiformes, Phytoseiidae) into the Forest-Steppe of Ukraine. Kolodochka L. A., Omeri I. D. — Evidences of more than 30 years (1975–2007) existence of the northern isolated population Forest-Steppe of Ukraine (near Kozyn Village, Obukhiv District, Kyiv Oblast, Ukraine) is given. It is considered as an example of unpremeditated introduction of a beneficial predating mite together with transported plants. This is the first registered and investigated case of invasion, acclimatization and inclusion biocoenosis as an equal right member for mites of the family Phytoseiidae.

Key words: phytoseiid mites, introduction, the Central Forest-Steppe.

Новые данные об успешной инвазии в лесостепную зону Украины вида-вселенца — средиземноморского хищного клеща *Typhlodromus beglarovi* (Parasitiformes, Phytoseiidae). Колодочка Л. А., Омери И. Д. — Обоснованное подтверждение 30-летнего (1975–2007 гг.) существования северной изолированной популяции средиземноморского вида *Typhlodromus beglarovi* Kuznetsov, 1984 в Лесостепи Украины (окр. с. Козин, Обуховский р-н, Киевская обл., Украина) как примера непреднамеренной интродукции полезного хищного клеща с завозными растениями. Для клещей семейства Phytoseiidae это первый исследованный случай инвазии, акклиматизации и вхождения в биоценоз в качестве равноправного члена сообщества.

Ключевые слова: клещи-фитосейиды, интродукция, инвазийный биотоп, Центральная Лесостепь.

Introduction

Human controlled phytocenoses are often made with using plants brought from other climatic zones. Together with formation of phytocenosis, another component of local biocenosis is made — acarocenosis as integral part of biocenosis, i. e. population of mites of different taxons interacting with plants in any way. Alien plants used as planting-stock are known rather often to be carrier for other organisms, both harmful and useful.

Representatives of mite associations which may be brought with plants not only from other territories of the same natural area, but also from other climatic zones, are introduced into acaricenosis of given biotope composed of mite species. It may be one of the ways to form specific complexes of acariphagous mites on exotic plants resulted in further changes in aboriginal acarifauna of all biocenosis and, as a consequence, modified efficiency of its activity.

Competition, usually arising after introducing species into new local association, due to selection, contributes to development adaptations to new environmental conditions. In successful outcome, it may results in acclimatization and, as a consequence, increased species diversity coexisting in the same space or association. Interspecific competition may go either to primordial formation of ecological equilibrium between alien and local species, or realize stricter scenario when one species squeezes out another one, ecologically similar, or forces it to develop other space or source of another food, i. e. to occupy another ecological niche. Naturally, that population with greater competitiveness is more stable. Closely related

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species, or species with very similar needs usually live in different geographical areas, or in the same area (sometimes biotope), but in different habitats, or avoid competition in some other ways, for example, due to differences in daily or seasonal activity. The pressure of natural selection is directed to elimination or prevention of long confrontation between species with similar life patterns. When ecologically similar species developed different adaptations and preferences, competition between them weakens and completely (or almost completely) disappears (Odum, 1986). In such cases alien species become the equal members of association and obtaine saving a status of adventive species.

In case of predatory mites playing regulatory role in cenose, such process can serve as one of the real ways for enriching of specific acaricomplexes owing to invading species.

There are few registered cases of transportation predatory mites with plants. However, they exist and need attention, because such passive migrations may result not only in some structural changes of acaricenoses, but in altered living efficiency of local mite association as a whole. This paper contains results of further observations of local source of reproduction of invading, appeared as a result of interzonal transfer of predatory mites to the territories distant from the place of their natural distribution (Kolodochka, 2002; Kolodochka, Omeri, 2007). Mite studies on the aforesaid territory were undertaken 30 years after the first studies to confirm possible long-term living of population of Mediterranean species *Typhlodromus beglarovi* Kuznetsov, 1984 in the forest-steppe, and to discover conditions allowed its survival.

Material and methods

Phytoseiid collections (collector Kolodochka) made in natural habitats of *T. beglarovi* (Mountain Crimea, 41 samples, 1976) and made near Kozyn village in 1975 (27 samples) were revised. In 2006–2007, pine plantations near Kozyn village were examined (territory of Kozyn and Koncha-Zaspa forestries, Obukhivskiy district, Kyiv oblast, Ukraine; 152 samples from three pine-tree species, collector Omeri), where the mites of species *T. beglarovi* were found earlier (Kolodochka, 2002; Kolodochka, Omeri, 2007). Phytoseiid mites were collected by standard method shaking them off from tree branches to the black paper and carrying with a moist brush into the test tubes with ethanol 70%. Mites were mounted into slides with using of Hoyer's medium which is the same that Faure–Berleze medium (Upton, 1993). Material is kept in collection of the Acarology department of Schmalhauzen Institute of zoology NAS of Ukraine (Kyiv).

Results and discussion

The first case of spreading predatory phytoseiid mites with alien plants was recorded in the USA (Seattle, state Washington) where on juniper (*Juniperus* sp.) planting-stock brought from Japan, mites were found and then described as a new species *Amblydromella juniperi* (Chant, 1959).

Later, in Kyiv oblast (environs of Kozyn village, Obukhivskiy district), small local population of phytoseiid mites *Typhlodromus beglarovi* was found in pine plantations. It was suggested to consider as accidental transfer of mites with planting-stock (Kolodochka, 2002). This species is described from the Crimea South coast where it is ordinary on Crimean pine-tree (*Pinus pallasiana* Lamb.) growing to the heights of 1000–1200 m above sea level. This species is considered to be a representative of Mediterranean fauna, because has not been met yet in natural plant associations on other climatic zones of Ukraine. In natural habitats, *T. beglarovi* mites have never been found on the same sample of plant together with mites from very similar species *Typhlodromus laurae* Arutunjan, 1974 also living in Mountain Crimea, but at heights more than 1200 m above sea level in the belt of Archangel fir (*P. silvestris* L.). These species avoid close contacts in places where these species inhabit contacting trees of Crimean pine and Archangel fir from successive vertical zonal belts, usual host plants for *T. beglarovi,* mites preferring Crimean pine, and *T. laurae* mites dwelling here mainly Archangel fir. Mites *T. laurae* populate Archangel fir on greater part of European territory (from Crimean mountains and the Caucasus to Norway, and from Ukraine to Netherlands and western part of Germany), and this allows to put it to boreal species (Kolodochka, 2002).

Revealed disjunction of *T. beglarovi* natural habitat looked unusually — this species was not met in investigated areas of territories covered with woods of Left-Bank Ukraine. Supposition about its delivery with planting-stock in the other climatic area was based on information about regular previous plantings of Crimean pine-tree near

Kyiv, especially extensively near Kozyn village. Formation of north isolated population outside the natural habitat *T. beglarovi* mites must be the evidence of successful entry of adventive species into local cenosis as an equal member of association in new area (Kolodochka, Omeri, 2007).

History of the forest plantations near Kozyn village showed that in 1960th there were extensive plantings of Crimean pine-tree, which roots on sandy soils better than Archangel fir, to make shelter-belt on a dam built in Dnieper bottomland flood-lands to protect village from floods. A forest shelter-belt was made on dam slopes, parallel to Kozynka riverbed. For the expired time, Crimean pine-tree plantations appeared to be destroyed by deforestations and fires. The rest of Crimean pine-tree plantations were found on few areas out of dam only, totally on 0.5 hectare inside a fresh pinery (type A2s). Trees at the age of 41–48 years (2005) were depressed, and some plantations were qualified as dead standing trees.

In the area examined, on Archangel fir, Crimean pine-tree and Labrador pine (*P. banksiana lamb.*), 12 species from 4 genera of predatory phytoseiid mites were found. Complex of 10 mite species on Archangel fir appeared to be the largest: *Amblyseius andersoni*, *A. rademacheri*, *Neoseiulus agrestis*, *Typhlodromus beglarovi*, *T. cotoneastri*, *T. laurae*, *T. pritchardi*, *Amblydromella* (s. str.) *inopinata*, *Amblydromella (Aphanoseius) clavata*, *A.* (*A.*) *verrucosa*. On Crimean pine-tree there were 6 species: *A. andersoni*, *E. finlandicus*, *T. laurae*, *T. pritchardi*, *A. clavata*, *A. verrucosa*. On Labrador pine, 4 species only were revealed: *N. maior*, *T. laurae*, *A. clavata*, *A. verrucosa*.

In collections of 1975, *T. beglarovi* was found in 12 out of 27 samples (51.9%), taken from pine-trees along Kyiv-Obukhiv motorway near Kozyn village and Koncha-Ozerna village. 11 samples contained *T. laurae*. Joint dwelling of these species was not found.

In collections of 2006–2007, *T. beglarovi* was found in 31 out of 113 samples: in 24 samples (21.24% of all samples) 'purely', and in samples from 7 trees (6.19%) together with species *T. laurae*. These species are very similar morphologically and ecologically, that determines their keen competitions and may explains reason for microbiotic separation of these obviously competitive species. Negligible percent cases of their joint dwelling on the same tree serves as rather forcible argument for such conclusion.

Mites *T. laurae* dwell on the whole sampling area (fig. 1, coloured inset, p. 192) and were found on all three pine species, while mites *T. beglarovi* were revealed on Archangel fir only. Analysis of mite spatial distribution showed that *T. beglarovi* population occupies narrow forest belt on one side of Kyiv–Obukhiv motorway along Kozyn village approximately 2 km long and 80 meters wide. Obviously, such form of the biotope appears to be suitable for survival invading species *T. beglarovi* and it is explained by its specific microclimate. The governing factor of such microclimate is, probably, constantly increased air temperature in a narrow forest belt closest to the motorway (no more than 100 meters from the roadside deep into the forest) maintained the whole year round.

The recent literary data directly indicated the great role of car exhaust in the global increase of air temperature (Environment..., 1999). By different estimations, their share in greenhouse effect is from 15% to 30 % of all sasiform emission. Carbon compounds contained in car exhausts may affect heating of air atmospheric even more than other gases contributed to climatic changes (Gubaydulin, 2003). It is known that exhaust gases make greenhouse effect and heat roadway keeping air warm above roadway covering and adjoining areas. Asphalt so noticeably increased air temperature that cities and towns fully covered with asphalted roads, streets and pavement make the greatest contribution to increased temperature of city air both in summer and in winter. Asphalted roads radiate heat continuously. In summer it is due to sun heating, in winter — to the friction of motor-car tyres. The information of satellite surveys show that cities, with their asphalted transport arteries, buildings, and car exhausts, cardinally affect even the

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global climate without saying of higher average annual values of air temperature in cities as compared to those suburbs and rural areas (by 0.56–5.6єC) (The greatest..., 2003). We realized, that it is impossible to transfer these data directly to conditions of the phenomenon in question, however, as there are no others, they can serve as reference point and a sort of confirmation of the working hypothesis, because the role of Kozyn village as emitter of additional heat and where the motorway passes, from the standpoint of these statements, is also obvious. Having analyzed configuration of biotope occupied by *T. beglarovi* population (fig. 1, coloured inset II, p. 192), we can state that mites of this species were not revealed on plants along a road outside a village projection. It may be an evidence of unique combination of heat sources needed for existence of this mite population. Most probably, the softening of extreme winter temperatures must be the determinative factor in the survival of mites *T. beglarovi.*

It should be also noted that contamination from motorways increase number of plant-feeding tetranichid mites which serve as food for predatory mites on plants growing on roadsides (Kruglikov, 1985; Zhovnerchuk, 2006). Accelerated development and reproduction of injurious mites in this case are obviously caused by increased temperature.

Consequently, the modern motorways actively affect environment, changing it by influence of numerous factors: air contamination with dust and aerosol blowouts from internal combustion engines creating dusting-smoke loops behind cars; effective mixing of air due to the turbulence of high-speed traffic; asphalted or concrete coverage, even in cold season of year heated to temperatures higher than those of air on adjoining area without such cover. We think that these factors are enough to provide the local steady increased air temperature both immediately above the highway area and adjoining territories.

In this case, in the area of joint thermal effect of motorway and village, necessary and sufficient microclimate was established for long-term survival adventitive population of Mediterranean predatory mites *T. beglarovi* in conditions of the northern part of the forest-steppe area of Ukraine. These conditions were supported by favorable biotic factors — abundant source of food, actively reproducing plant-feeding mites.

It is possible that other factors promoting the life activity of population of adventitive species or their complex action dropped out of sight of the authors of this study, and in future it may need participation specialists of other areas of knowledge. Here we establish the fact of long-term, for more than 30 years (1975–2006), existences of northern isolated population of species *T. beglarovi* in the Forest-Steppe of Ukraine (near Kozyn village, Obukhiv district, Kyiv oblast, Ukraine), as an example of unpremeditated introduction useful predatory mite — representative of the Mediterranean fauna with imported plants.

Conclusions

Long-term survival (for more than 30 years) isolated mite population of the Mediterranean species *Typhlodromus beglarovi* in the forest-steppe area confirms really possible invasion of phytoseiid mites in ecologically similar biotopes in other climatic areas. Successful acclimatization and further stable existence of local population invasion species *T. beglarovi* in new conditions appeared to be possible thanks to successful combination of different biotic and abiotic factors: local greenhouse effect due to the thermal radiation of motorway and village; abundant food (plant-feeding mites serving as food for predatory mites are more abundant on trees weakened by dust and cars exhaust contaminations); successful decision of antagonistic relationships with ecologically similar species *T. laurae;* and successful resistance to competition pressure on invader from the side of other local phytoseiid species with not very close, but, nevertheless, similar way of life.

This is the first especially investigated case of invasion mites from family Phytoseiidae, their successful acclimatization and formation of stable population of adventitive species at his interzonal invasion from a distant natural area.

This phenomenon of interzonal invasion and including adventitive species in a local cenosis translates such way of enriching local faunas from solely theoretical into practical aspect. Increase of specific variety of local cenosis appears to be absolutely possibly even after unpremeditated introduction thanks to successful acclimatization of invading predatory mites. It increases in a local fauna the number of effective acariphagous species suitable for control numbers of local plant-feeding mite and small insects that resulted in raised functional and productive stability of local cenosis.

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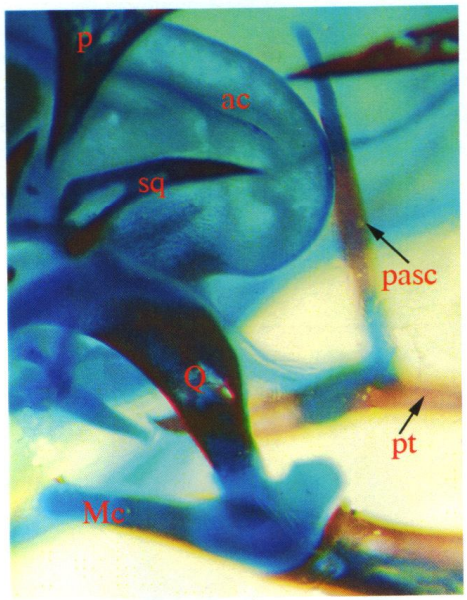
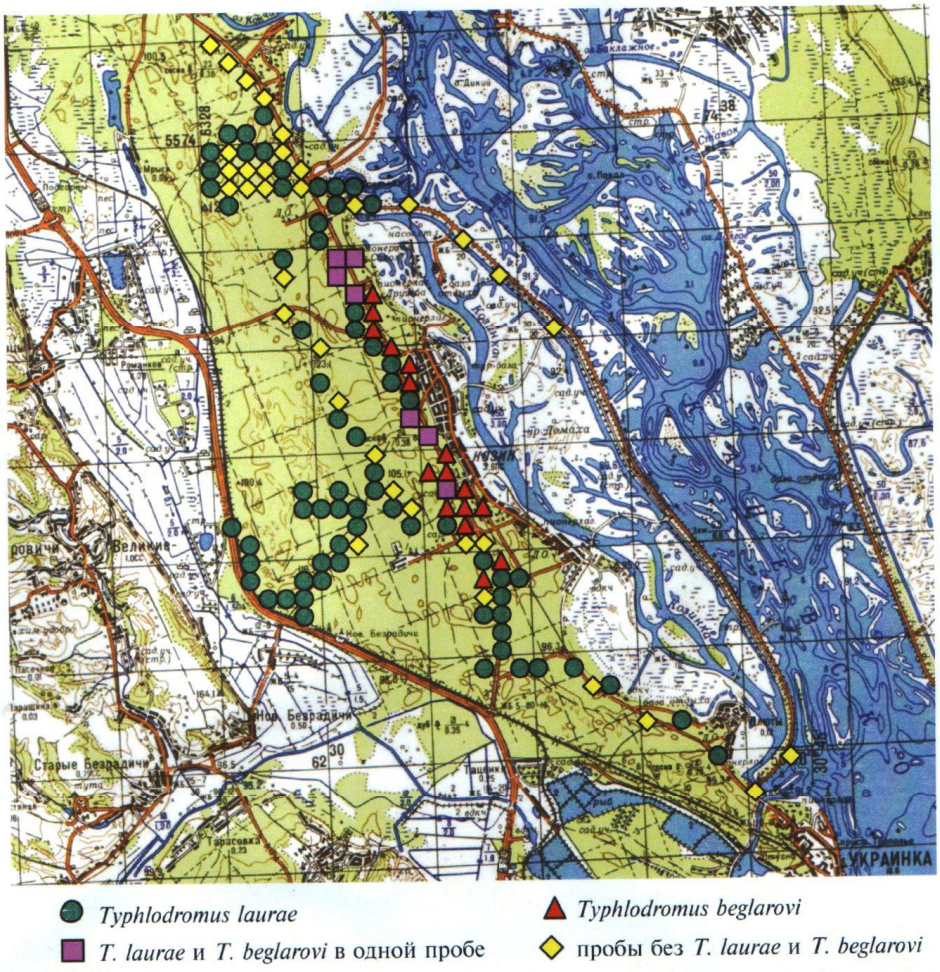


Inset to the paper by A. N. Yarygin (p. 113). Fig. 12. Head of *Lacerta agilis* embryo at stage 36+. Lateral view. ac — auditory capsule, Mc — Meckel's cartilage, p — parietal bone, pasc — processus ascendens, pt — pterygoid bone, sq — squamosal bone, q — quadrate.

К статье А. Н. Ярыгина (с. 113). Рис. 12. Голова эмбриона *Lacerta agilis* на стадии 36+. Вид сбоку. ac — слуховая капсула, Mc — меккелев хрящ, p — теменная кость, pasc — восходящий отросток, pt — крыловидная кость, sq — чешуйчатая кость, q — квадрат.



Inset to the paper by L. A. Kolodochka, I. D. Omeri (p. 169). Fig. 1. Mapped places of phytoseiid mites collections near Kozyn village (Obukhiv region, Kyiv oblast, Ukraine).

К статье Л. А. Колодочка, И. Д. Омери (с. 169). Рис. 1. Карта-схема мест сборов клещей семейства Phytoseiidae в окр. с. Козин (Обуховский р-н, Киевская обл., Украина).