

**The handsome cross grasshopper
Oedaleus decorus (Germ.) (Orthoptera:
Acrididae) as a newly emerging pest
in the south-eastern part of
West Siberian Plain**

Kristina V. Popova, Natalia S. Baturina, Vladimir V. Molodtsov,
Oxana V. Yefremova, Vasily D. Zharkov and Michael G. Sergeev

Department of General Biology and Ecology, Novosibirsk State University,
2 Pirogova Street, Novosibirsk 630090, Russia

Laboratory of Invertebrate Ecology, Institute of Systematics and Ecology of
Animals, Siberian Branch, Russian Academy of Sciences,
11 Frunze Street, Novosibirsk 630091, Russia;

Correspondence: mgs@fen.nsu.ru; mgsergeev@aol.com

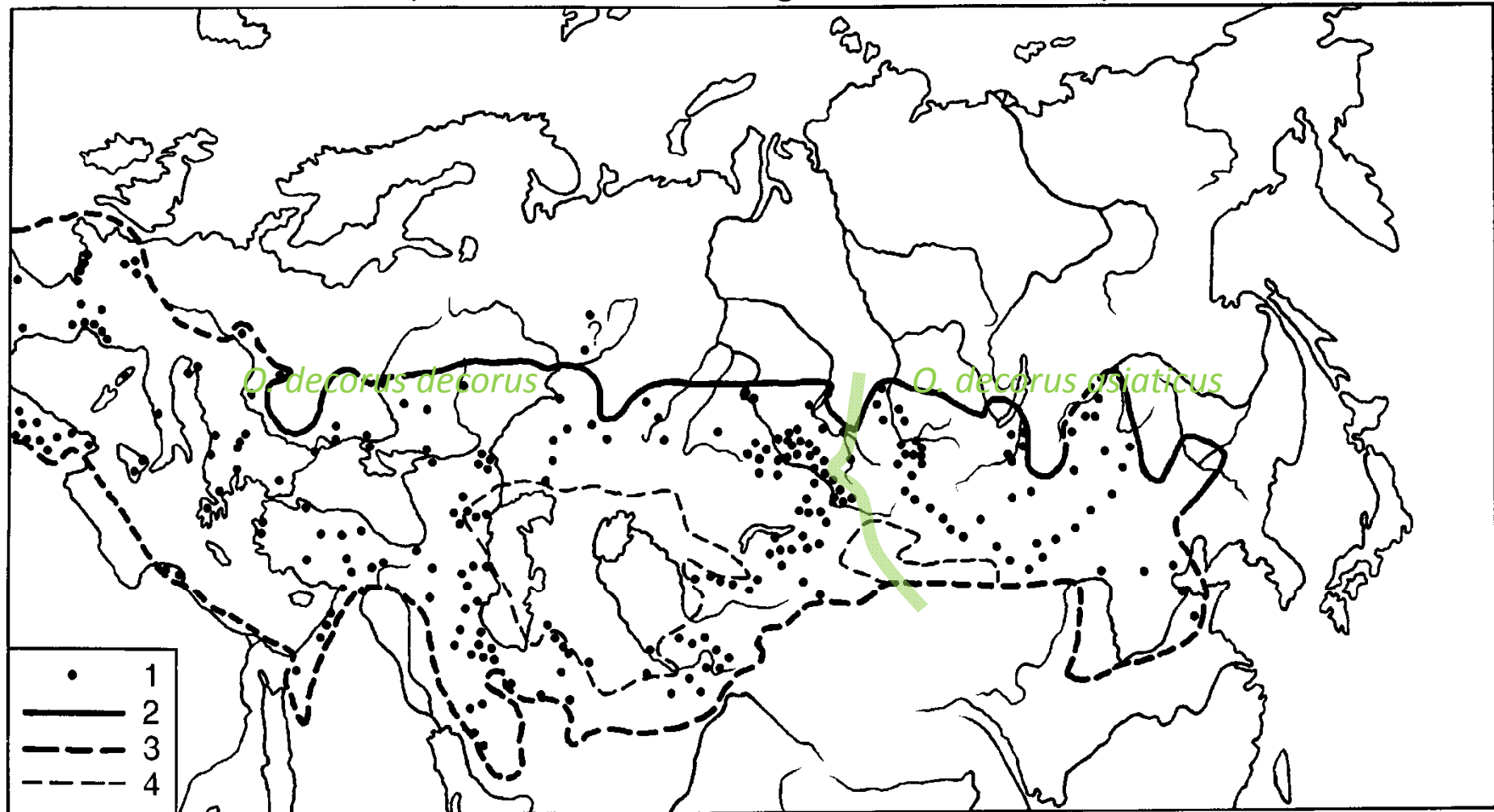
Oedaleus decorus (Germar, 1825) or the handsome cross grasshopper is a widely distributed species over the Eurasian semi-arid territories (mainly across forest-steppes, steppes, semi-deserts, Mediterranean and mountain dry grasslands), from the Atlantic coast to the Pacific one.

During outbreaks it can seriously damage cereals, pastures, and hayfields. However, in the south-eastern part of West-Siberian Plain, one of the main agricultural region of Russia, until the 1960s this species occurred mainly in the dry steppes, its abundance was low, and it was not considered as a pest. During the 20th century ecosystems of this region have been significantly changed by human activity. In the second half of the last century, such ecosystems' transformations resulted in species distribution changes.

The aim of this presentation is to show how the distribution of *O. decorus* over West Siberian Plain has shifted.

General distribution of *Oedaleus decorus*

(after Ritchie, 1981; Sergeev, 1986 and 1997)



1 – known localities; 2 and 3 – outer boundaries of the range; 4 – desert areas inside the range; green – approximate position of the boundary between *O. decorus decorus* and *O. decorus asiaticus*



Oedaleus decorus decorus in the typical habitat of the Kulunda steppe (West Siberia)

Oedaleus decorus asiaticus in the typical habitat of Central Tuva steppe (Altay-Sayan Mts.0)



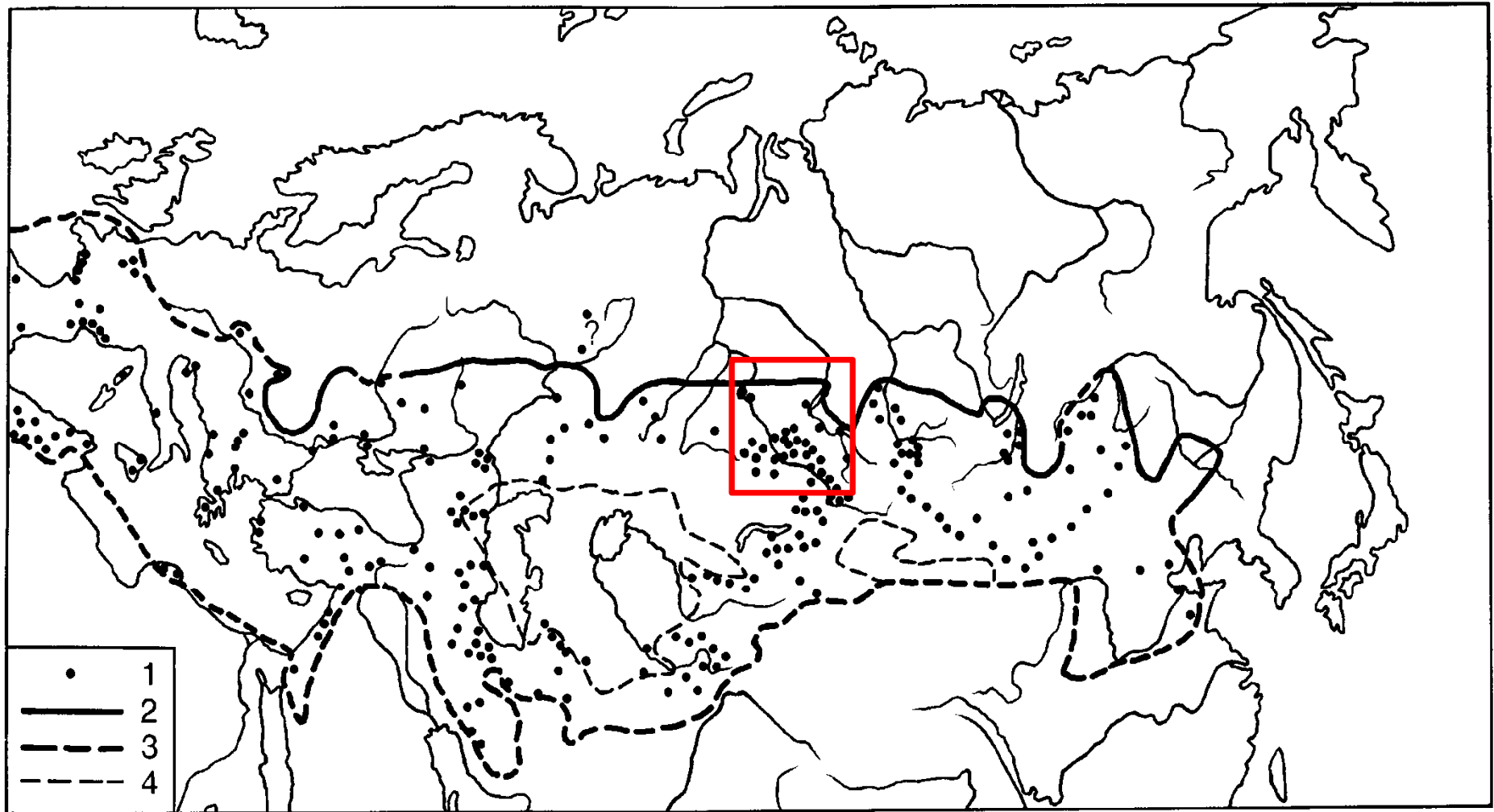
Original data were collected from 1979 until 2019 in the south-eastern part of West Siberian Plain. Originally this area was characterized by grasslands and forests. Later the south-eastern part of West Siberian Plain was mainly converted to agricultural lands (fields and pastures).

The peculiarities of grasshoppers' distribution were characterized by quantitative and qualitative samples collected in natural and transformed ecosystems. Samples captured during a fixed period of time were done in every habitat studied. Using this method, insects were collected with a standard net (40 cm diameter) over a period of 10–30 minutes. Results for each habitat were transformed to an hour. In many cases, especially during locust outbreaks, we also counted acridid densities on arbitrarily placed plots 0.25 x 0.25 m² (in some cases — 0.5 x 0.5 m²).

We also analyzed some old data (1961–1980) and checked some previous species identifications. We used the Glonass/GPS navigators to determine geographical coordinates of localities. For localities explored before 2000 we used Google Earth Pro (©Google, 2020) to get the same parameters. We also used data from different publications for the first half of the 20th century and data for some specimens from the collections. The geographic coordinates for almost all old localities of grasshoppers (> 134) were determined. These data were compared with data for 1961–2019 (162 localities for all acridid insects).

Maps of species distribution were produced on the basis of geographic coordinates with MapInfo 12.03.

Studied territory



Typical habitats of *Oedaleus decorus* in the south-eastern part of West Siberian Plain



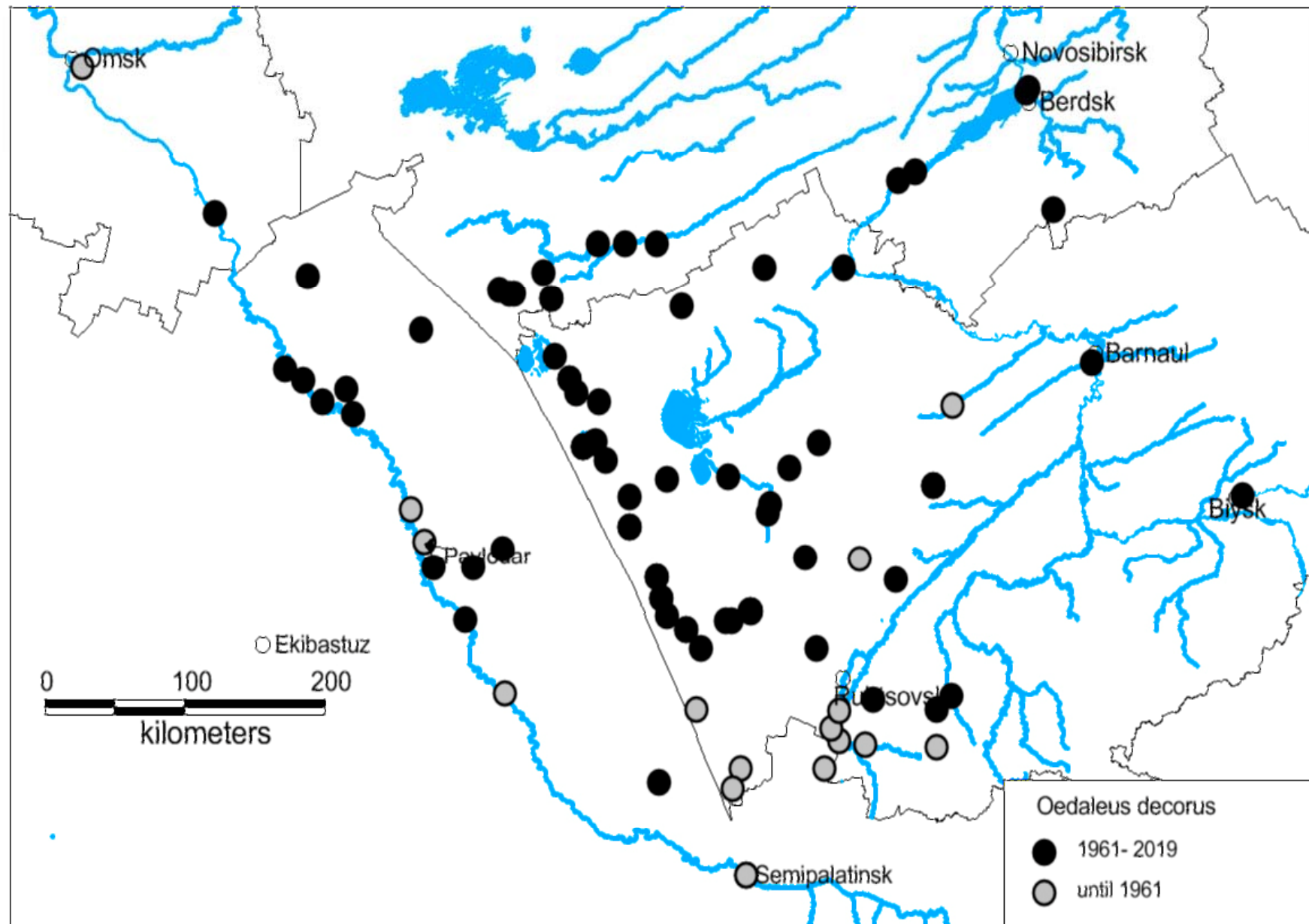


Oedaleus decorus decorus, male,
brown form



Oedaleus decorus decorus, female,
green form

Distribution of *Oedaleus decorus* over the south-eastern part of West Siberian Plain until the 1960s and after 1961



Until the middle of the 20th century, *O. decorus* was mainly distributed in the southern parts of the region and was commonly associated with the dry steppes. The only known exception was the locality in the vicinities of Omsk (about 55°N — the forest-steppes of the Irtysh River basin).

Our data show that in the 1970s, the species occurred already across the whole Kulunda steppe (up to 54°N). In the 1990s, *O. decorus* crossed the 54th parallel and its populations were observed in the southern parts of the forests-steppe. In 1999, its specimen was found in the southern part of Novosibirsk, in Novosibirsk Scientific Center of Russian Academy of Sciences, on the right (eastern) side of the Ob River. This locality became the north-easternmost one on West Siberian Plain. Later several colonies of this species were observed in the forest-steppes on the right side of the Ob River. They were commonly associated with dry transformed habitats, e.g., with overgrazed meadow steppes, lawns, and roadsides.

Nowadays *O. decorus* became the widely distributed grasshopper over the south-eastern parts of West Siberian Plain and occupies all steppe areas and the southern parts of the forest-steppes between the Irtysh and Ob Rivers. Besides, it also spread across the forest-steppes on the eastern side of the Ob River and colonized some transformed habitats.

In the 1920s, the abundance of *O. decorus* was relatively low. Bey-Bienko [1930] noted that this species was relatively numerous only on the sandy dunes in the southern part of the Kulunda steppe in Kazakhstan, and rare in some adjacent habitats with dominance of short grasses and sagebrushes. However, *O. decorus* was very common in the semi-deserts of East Kazakhstan.

In the end of the 20th century and in the beginning of the 21th century, the handsome cross grasshopper became very abundant in the steppe habitats, especially during warm and dry summers. During the Italian locust outbreaks, its abundance may be very high and comparable with the abundance of *Calliptamus italicus*. The Spearman rank-order correlation coefficient for the long-term dynamics of populations of *O. decorus* and *C. italicus* is relatively high for each plot studies and very high if we summarize data for all plots ($r_s = 0.917$, $p < 0.001$).

Dynamics of the average abundance (ind. per hour) of *O. decorus* relative to the average abundance of the Italian locust in the Kulunda steppe

Year	Aleksandrovskij	Yarovoe	Ust-Volchikha
	53.67°N78.25°E	52.85°N78.57°E	51.93°N80.28°E
	northern steppe	dry steppe	dry steppe
2000	1146 / 2682	252 / 582	474 / 144
2001	210 / 246	54 / 450	24 / 234
2002	6 / 0	0 / 24	72 / 42
2003	6 / +	0 / 4	6 / 6
2004	0 / +	0 / 4	0 / +
2005	0 / 24	54 / 6	0 / 0
2006	0 / 18	60 / 30	6 / 0
2007	18 / 84	150 / 60	20 / +
2008	60 / 78	144 / 6	40 / 0
2015	+ / +	4 / 0	204 / 480
2018	+ / 6	?	17.2 / 17.1
Spearman's correlation	0.586	0.609	0.518
	(p = 0.058)	(p = 0.063)	(p = 0.102)

Abundance of *O. decorus* / abundance of the Italian locust; + — one or several specimens were found beyond counts; ? — no data.

Since the 1960s, in the south-eastern parts of West Siberian Plain, the distribution pattern of the handsome cross grasshopper changed significantly. Nowadays *O. decorus* occupied almost all local steppes and the southern part of the forest-steppes, up to 55° N, and spread over the forest-steppes on the right (eastern) side of the Ob River too. These changes may be explained by both climatic changes (especially northward) and some transformations in human activities (mainly for eastward spreading). One can suppose that in the nearest future this species will continue to spread eastward and penetrate into the so-called Kuznetsk steppe in the Kemerovo Region.

The species became very common and occurs in almost all steppe habitats in the steppe life zone and on plots with xerophytic and mesoxerophytic vegetation on the eastern side of the Ob River. In 1999–2002 the abundance of *O. decorus* was very high in the Kulunda steppe between the Irtysh and Ob Rivers. This period of its long-term dynamics may be qualified as the local outbreak.

It is vitally important that local populations of *O. decorus* often became very abundant in the same habitats and in the same periods as the Italian locust (*C. italicus*) — one of the most important pests in the region. In this case, the situation for plant protection services may be very complicated, because the handsome cross grasshopper (*O. decorus*) is more or less typical grass feeder, while the Italian locust prefers dicots. Besides, in the local steppe populations, there is some opportunity of prospective emergence of certain peculiarities of gregarization as described for populations of *O. decorus asiaticus* in Inner Mongolia [Le Gall et al., 2019; Cease et al., 2010, 2017].

We thank all our colleagues and students (especially O. Denisova, O. Ermolaeva, and I. Vanjkova) for their valuable help during collecting field data. We are also indebted to all companions during our numerous field trips. We wish to express our special thanks to the late L.L. Mistshenko (Saint Petersburg), the late I.V. Stebaev (Novosibirsk), and the late G.P. Ostroverkhova (Tomsk) for their cooperation.

These studies were financially supported by the joint program of the Russian Foundation for Basic Researches and the Government of Novosibirsk Region (18-416-540001 and 20-416-540004), and also by the Federal Fundamental Scientific Research Program (FWGS-2021-0002).