

Movement studies in the Rufous grasshopper, *Gomphocerippus rufus* (L.)

Stefan Opitz

Institute of Ecology

Friedrich Schiller-University Jena, Germany

Samenvatting

Om de kwetsbaarheid te bepalen van populaties van een soort is het belangrijk iets te weten over de grote en aard van haar "territorium" en haar dispersievermogen. In een groot en in een klein terrein nabij Jena (Duitsland) werden in 1994 en 1995 totaal ca. 350 exemplaren van de Rosse sprinkhaan voorzien van een reflecterend strookje en van een schijfje met een nummer. Door het strookje konden de dieren 's nachts eenvoudig worden teruggevonden, en hun positie op een kaart weergegeven. Het blijkt dat mannetjes een groter "territorium" hebben en zich verder verspreiden dan vrouwtjes; in het grote terrein waren beide maten groter dan in het kleine terrein. Verder bleek dat de dieren uit het kleine terrein zich significant meer ophouden in vegetaties met Dravik en in stukken met kruiden en struiken niet hoger dan 60 cm, terwijl stukken met hogere vegetaties of kale grond juist gemeden werden.

Résumé

Etudes sur la mobilité de *Gomphocerippus rufus*

La détermination de la vulnérabilité d'une espèce demande une connaissance de l'étendue et de la nature de son "territoire" et de sa capacité de dispersion. Dans un site à grande superficie ainsi que dans un site beaucoup plus petit, près de Jena (Allemagne), env. 350 exemplaires de *Gomphocerippus rufus* ont été marqués d'un ruban réfléchissant et d'un disque numéroté. A l'aide de ce ruban, les animaux pouvaient facilement être repérés durant la nuit, et leurs positions ont été cartographiées. Les mâles semblent avoir un "territoire" plus grand et ils se dispersent sur une plus grande distance; dans le site à grande superficie les distances parcourues par les deux sexes étaient plus grands. En outre, les animaux du petit site se tenaient plus dans les végétations à *Bromus* et dans les parties à herbes et buissons d'une hauteur de moins de 60 cm, tandis qu'étaient évitées les parties à végétation plus haute ou celles sans végétation.

Within a German wide research project "Importance of isolation, habitat size and habitat quality for the survival of animal and plant populations on dry grasslands" studies on mobility and habitat use of the Rufous grasshopper (*Gomphocerippus rufus* (L.)) have been undertaken at Mesobrometum plots south of Jena/Thuringia. Movement data provide qualitative and quantitative references about habitat requirements of this species. This is important to protect populations and their habitats. Furthermore these studies contribute to population vulnerability analyses.

The research was carried out during the summer and autumn of 1994 and 1995 at two Mesobrometum plots in the nature reserve "Leutatal" south of Jena. Both plots are inclined 14–35° to the south and distinguished by their different sizes (3100 m² and 700 m²).

To investigate movement parameters, between 65 and 100 individuals were marked and released on each plot, both in 1994 and 1995. Small pieces of reflection tape were fixed on the hind tibiae of the adults. This enables

to find them in darkness quite easily by sweeping the study plots with a lamp. Furthermore, a small, numbered plastic disc was glued on the pronotum to recognise grasshoppers individually. From the middle of August (marking date) until November (last observation of a marked grasshopper) the study plots were checked by night (once a week in 1994, every third night in 1995). Observations were registered using a map that divided the habitat in 5 x 5 m quadrats.

The studies on mobility were focused on linear and spatial movement parameters. Dispersal range - a linear parameter of long time mobility - gives informations about the ability of local dispersal of studied populations (Köhler, 1996; Samietz et al., 1996). Individuals with at least 4 observations were used to calculate dispersal ranges, being the largest distance between the observation points of an individual. Home range - a spatial parameter - means the activity area of a grasshopper within the habitat. At least 5 observations per grasshopper was the criteria for home range calculations. Two methods - convex polygon (Hayes,

1949) and harmonic mean (Dixon & Chapman, 1980) - were used to determine this parameter based on observation points (Table 1).

Results were evaluated regarding the individual differences in both sexes. Additionally, the dependence of mobility on population density as well as on environmental parameters like habitat size and climatic conditions have been considered.

The first results showed that the medians of dispersal range and home range in males are larger than in females (Table 1). The comparison between the two study plots in 1994 showed higher values for the larger plot. The considerable differences in the dispersal ranges and home ranges between 1994 and 1995 for the smaller study plot could be a methodical artifact caused by the much higher observation frequency in 1995, but climatic differences between those years might be another possible cause and checking still needs to be done. The values for the large plot in 1995 are still not available.

The present results only partly give information about the mobility of the studied species. There are still unanswered questions about movement of larvae and immature adults, factors about which little is known. Long distance travellers have not been found. There is no idea about their existence and the potential ability of *G. rufus* to colonise new habitats or about the gene flow between populations.

To get references about habitat use of *G. rufus* within their study plots, the correlation was studied between the distribution of observed grasshoppers and certain habitat structures. The percentage coverage of *Bromus erectus*, *Brachypodium pinnatum*, herbs and shrubs less than 30 cm height, herbs and shrubs of heights between 30 and 60 cm, herbs and shrubs of more than 60 cm height and open soil patches were estimated for each 25 m²-quadrat of the study plots. Whereas no correlation was found at the large plot, results at the small one are different. Here the distribution of the observed male and female grasshoppers is highly positively correlated with the coverage of *Bromus erectus*, herbs and shrubs up to 60 cm height, and negatively correlated with open soil patches and herbs and shrubs of more than 60 cm height (Table 2).

Relatively low values of dispersal range and home range showed a considerable philopatry of *G. rufus* within the studied plots. This concurs with most of the other grasshopper species studied (summary in Ingrisch & Köhler, 1997). Biotic and abiotic factors like plot size seemed to influence the movement parameters. Indirectly, the observation points gave informations about the habitat structures the grasshoppers prefer. Nevertheless, different results at different plots indicated a high degree of habitat specificity. Comparable studies on *Stenobothrus lineatus* at the same study area showed differences in habitat utilization. Whereas *G. rufus* prefer structures with *Bromus erectus* as well as herbs and shrubs up to 60 cm height, *S. lineatus* significantly avoid herbs and shrubs of more than 30 cm height. The habitat utilization of *S. lineatus* is closely related to the distribution of *Bromus* tussocks (Samietz, 1996). Contrary to the broader structural niche of *G. rufus*, *S. lineatus* shows a higher specialization with regard to habitat structures.

References

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Table 1: Median values of dispersal range and home range of *G. rufus*. Numbers of individuals are printed in parentheses; bold numbers indicate statistical significance between males and females ($p < 0.05$)

		dispersal range [m]		home range [m ²]			
		male	female	convex polygon		harmonic mean	
				male	female	male	female
1994	large plot	20 (13)	15 (19)	111 (12)	58 (16)	308 (12)	136 (16)
	small plot	13 (17)	12 (20)	70 (15)	29 (19)	148 (15)	82 (19)
1995	small plot	22 (26)	17 (28)	100 (24)	60 (26)	226 (24)	180 (26)

Table 2: Correlation coefficients r (Pearson) between the distribution of *G. rufus* and habitat structures at the small plot in 1995. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; n.s. not significant.

	open soil	<i>Brachypodium</i>	<i>Bromus</i>	herbs and shrubs		
				< 30cm	30 - 60cm	> 60cm
male	-0.384 *	0.096 n.s.	0.656 ***	0.504 **	0.448 **	-0.334 *
female	-0.307 *	0.198 n.s.	0.579 ***	0.532 ***	0.418 **	-0.383 *