COEXISTENCE OF SYMPATRIC SIBLING WOOD ANTS THROUGH SPATIAL NICHE PARTITIONING

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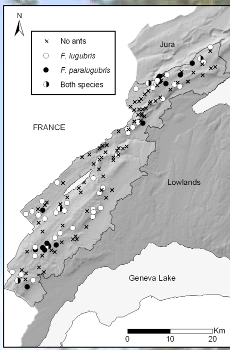

Figure 1. Study area in the Swiss Jura Mountains with sampling results.

INTRODUCTION

Formica lugubris and *Formica paralugubris* are two sympatric sibling wood ant species found in alpine forest ecosystems. According to the conventional rules of competition (Hutchinson 1957), one of them should be excluded. To elucidate this question, spatial niche partitioning by mesohabitat (25 m^2) differentiation is examined on a large sampling scale in the Swiss Jura Mountains through model comparison.

Table 1. Behavioural traits of *Formica lugubris* (*italic* = not entirely proved, based on Rosengren *et al.* 1993 and pers. obs.) and *Formica paralugubris* (Cherix *et al.* 1991) in the Swiss Jura Mountains.

	Formica lugubris	*Formica paralugubris*
COLONY SOCIAL STRUCTURE	*one queen* and one nest	several queens and nests
REPRODUCTION (main strategy)	*nuptial flight*	intra-nest mating
DISPERSAL STRATEGY	*long distance*	local
COLONY MULTIPLICATION	*foundation by social parasitism*	colony budding
SPATIAL OCCUPATION	**sparse**	**local dominance**

HYPOTHESIS

METHODS

Occurrence data (nest number) were collected in the Swiss Jura Mountains (Fig. 1) using a random-stratified sampling design (Table 2). Habitat distribution models were fitted for each species using a set of meaningful GIS environmental predictors (Table 3). Models (GLMs) implemented in a GIS allowed to obtain a potential habitat distribution map for each species (Fig. 2 and 3). Because of the social structure difference, predicted nest densities are represented by unequal classes, fixed on the basis of sampling results.

Table 2. Factors used to stratify the sampling were those most likely to influence these ants species on an *a priori* basis. Each stratifying factor was divided in two classes.

Factor	Class 1	Class 2
ELEVATION	800 m - 1200 m	1200 m - 1677 m
SLOPE ASPECT	South - East	North - West
SLOPE ANGLE	weak (1°- 20°)	steep (25°- 45°)
POSITION	inner forest	forest edge

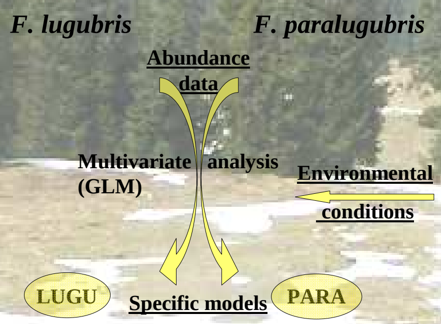

Table 3. Environmental predictors used for models calibration.

Abbreviation	Variable
SFROYY	Number of frost days during plants' growing season.
DDEG300	Degree-days of growing season with a 3°C threshold
SDIRYY	Direct solar radiation (average monthly mean)
TOPO	Topographic position
DRESLIS	"Forest edge effect" pondered by coniferous density

RESULTS

Tables 4. Parameters of models LUGU and PARA (GLM results)

Predictor	p-value (coefficient)	Average % expl. deviance
(INTERCEPT)	***	-
DRESLIS	***	11.64
SFROYY^2	***	8.12
SDIRYY	***	6.16
SFROYY	***	5.40
SDIRYY^2	***	5.02
DDEG300^2	***	1.76

Predictor	p-value (coefficient)	Average % expl. deviance
(INTERCEPT)	***	-
TOPO^2	***	10.79
DDEG300^2	***	7.49
SFROYY	***	6.45
SDIRYY	***	4.95
SFROYY^2	***	4.29
DRESLIS	***	2.11

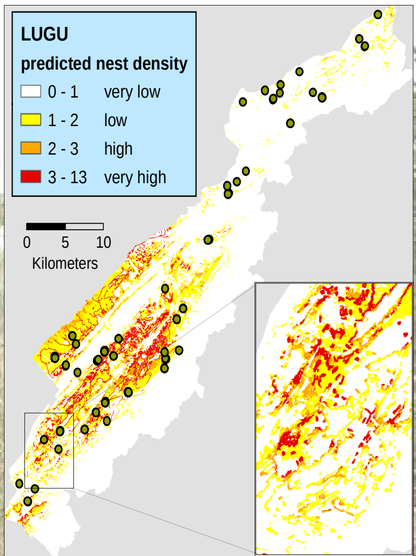

Figure 2. Potential distribution map of ***F. lugubris***

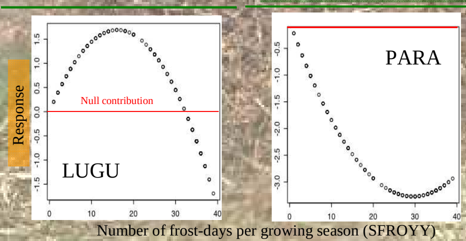

Figure 4. Impact of frost-days frequency on the abundance of each species.

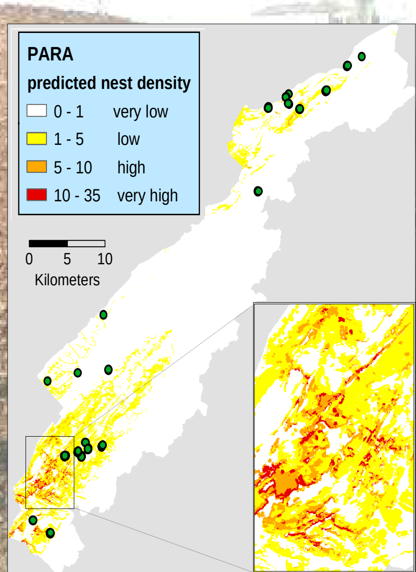

Figure 3. Potential distribution map of ***F. paralugubris***

The two species share very similar habitats, only differentiated by the topographic exposure (TOPO) and the response to the frequency of frost events (SFROYY). They nevertheless exhibit distinct distribution patterns in the study area: ***F. lugubris*** and ***F. paralugubris*** occur respectively more frequently at woodland borders and into the forest (DRESLIS).

DISCUSSION

The study of wood ant sibling species through a spatial modelling approach allowed to highlight some niche differences, making their coexistence more easily understandable. Patterns and modelling results confirm the hypothesis of a spatial segregation at a local scale. This corroborates the idea of distinct reproductive strategies (dispersal opportunist *vs* resident specialist). This work is an important contribution to the conservation of near-threatened wood ant species (IUCN red list).

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