

**NEST TURNOVER IN A COLONY
OF *FORMICA PRESSILABRIS* NYLANDER, 1846
AS RELATED TO HABITAT QUALITY
(HYMENOPTERA: FORMICIDAE)**

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In a *F. pressilabris* colony in a primary habitat in NE Poland, an annual nest turn over-rate of 53% was found. Such dynamics are known for several ant spp. In this study, several known causes for colony dynamics were checked for *F. pressilabris*. Competition and nest microclimate change could be excluded as causes. Interspecific conflicts such as predation or competition were improbable, since nests in close vicinity to those of other *Formica* spp. were not abandoned, and *F. pressilabris* is foraging in young, aphid-infested *Populus* sprouts, whereas other *Formica* spp. forage in elder trees. There were no significant differences in development of vegetation density over the nests between persistent, abandoned and newly founded nests, this excluding change of nest microclimate. As a cause for colony dynamics, accidental and tempo-spatially unpredictable changes of food availability are proposed. 10-30 cm high sprouts of *Populus tremula*, potentially aphid-infested, grew interspersed between the colonies. Some of these potential food sources were browsed by game or cattle in irregular intervals and without spatial specificity. This stochasticity could be balanced by the satellite nest strategy. These small nests are always founded in the immediate vicinity of potential food sources. It is possible, if the food source is persistent, the satellite nest becomes a stem nest, if not, it is abandoned and new nests are founded elsewhere.

INTRODUCTION

The functional importance of ants in various ecosystems is well recognized since some time (e.g. PETAL, 1977, 1980; KJELLSSON, 1985;

HÖLLDOBLER & WILSON, 1990; KARHU & NEUVONEN, 1998). Therefore, ants are not only recognized bio-indicators, but also target species in numerous conservation measures (STEINER & SCHLICK-STEINER, 2002). Of all Middle European ant species, all (*Copto*)*formica* species in Germany and its neighbouring countries belong to the most endangered, many are threatened by extinction. Changes of land use or atmospheric eutrophication of the landscape (see BAKKER & HEERDT, 2005) are given as causes (e.g. SEIFERT, 1998; LAUTERER, 2003). This made and makes intensification of protective measures necessary (AGOSTI, 1989; GLASER, 1999; CZECHOWSKI et al., 2002; WESENIGK-STURM, 2002a; BÖNSEL & BUSCH, 2003). However, effective protection is difficult to achieve for these species, since knowledge about their autecology is sketchy. This can partly be attributed to the problem of taxonomic identification of colonies, which is possible only recently with certainty (SEIFERT, 2000). It is possible that some of the colonies referred so far to *F. pressilabris* will be identified as *F. foreli*, and vice versa. According to the present state of knowledge, habitat requirements of both species are very similar, even co-occurrence is possible. Both species are known to colonize oligotrophic habitats, of which *F. pressilabris* prefers the xerothermic ones (cf. KUTTER, 1956, 1957, 1966; SEIFERT, 2000). To preserve these highly endangered species in their respective localities, ecological habitat requirements as well as spatial dynamics of the colonies need to be known sufficiently. For the planning of maintenance measures such as mowing, grazing, burning or tilt cutting, it needs to be known whether the respective (*Copto*)*formica* species inhabits the same nest for longer periods, as do the large *Formica* species of the *Formica rufa-Formica polycтена* group (GÖßWALD, 1990), or whether there is a spatio-temporal variability of nest sites and which are the causes for that. Spatial dynamics is proven for several *Coptoformica* species, or at least tendencies are suggested, but the causes for colony movements are largely unknown (CZECHOWSKI, 1990; BÖNSEL & BUSCH, 2003; BLISS & PIEL, 2004; SÖRENSEN, 2004). Up to now, nest disturbance, nest microclimate change, competition or spatio-temporal dynamics of food availability are given as direct or indirect causes for colony dynamics in several species (e.g. WHEELER, 1926; HIGASHI & YAMANCHI, 1979; HERBERS, 1985; HÖLLDOBLER & WILSON, 1990). THERAULAZ et al. (2002) suggest that ants generally attempt to form spatial patterns, though in a highly manipulative experiment.

Here, a detailed ecological analysis of a *F. pressilabris* colony is presented. First, potential differences to the habitat requirements between *F. pressilabris* and *F. foreli* and the possible existence-threatening trends of

F. pressilabris should be discussed. Second, causes for colony movements, as listed above, and the pattern formation, as suggested by THERAULAZ et al. (2002) were checked.

MATERIAL AND METHODS

STUDY AREA AND FIELD PROCEDURES – The study area is located in the Biebrza valley in northeastern Poland (53°19'N; 22°34'E, 109 m NN), in one of the last intact percolation mires of Europe (SUCCOW & JESCHKE, 1986) with a total area of 80.000 ha. Mean annual precipitation in the study area is 540 mm, mean annual temperature is 7.6°C (ZUREK, 1991). Here a colony of *F. pressilabris* inhabits a mineral outcrop covered with sand, which is isolated by the surrounding bog. It will be a polygynous colony, even if specific examinations of this problematic nature were not carried out. A permit for ditching in nests and looking for one or more queens was not given.

The study area covers 1.5 ha, 25% shaded by *Quercus petraea* and *Tilia cordata*. 5% of the area are open sandy patches. 70% are covered by an herb layer which can be subdivided in various sub-layers. Soil type and plant community can be classified as dry grassland (see BÖNSEL & RUNZE, 2000). Anthropogenic disturbances are low in intensity and frequency, they consist in occasional grazing of 12-21 heads per ha of cattle. This utilization is being maintained for centuries now (OKRUSZKO, 1990) and is comparable to that of game (WILMANN, 1997).

The study area was marked with a grid of 20×20 m cells. All *Formica* nests of the respective year (2000 and 2001) were recorded in August, marked with red pegs and recorded by tachymetry; existence of last year's nests was checked by tachymetry. Additionally to the nest locations, the macro-relief of the study area was surveyed, allowing for determination of nest exposition. Nest height and diameter were recorded. Vegetation density over any nests, including the ones abandoned in 2001, was calculated as the product of degree of coverage (%) and mean plant height of herb- and shrub layer (cm) (see SEIFERT, 1986). For example, 55% coverage and a mean plant height of 26 cm resulted in a vegetation density of 1430. It was calculated for an area exceeding the nest periphery by 10 cm.

PROCESSING OF DATA – The survey data of the study area and the nest locations, their height and diameter in 2000 and 2001 were transferred to a geographical information system (GIS). The vegetation was digitized of field map on which plant communities were mapped according to DIERSCHKE, (1994). This allows exact determination of exposition and position of nests in specific plant communities. Nests were assigned to yearly GIS-layers and superimposed to obtain an operationalized spatio-temporal model of the colony (BILL, 1996), which allowed for exact determination of persistence, foundation or abandonment of nests. Additionally, nests were classified by diameter to elucidate the spatial distribution of stem- and initial nests (Fig. 1). Nest height, diameter and vegetation density were compared with the t-test between the identical nests in 2000 vs. 2001 and persistent nests vs. abandoned nests or persistent nests vs. new founded nests.

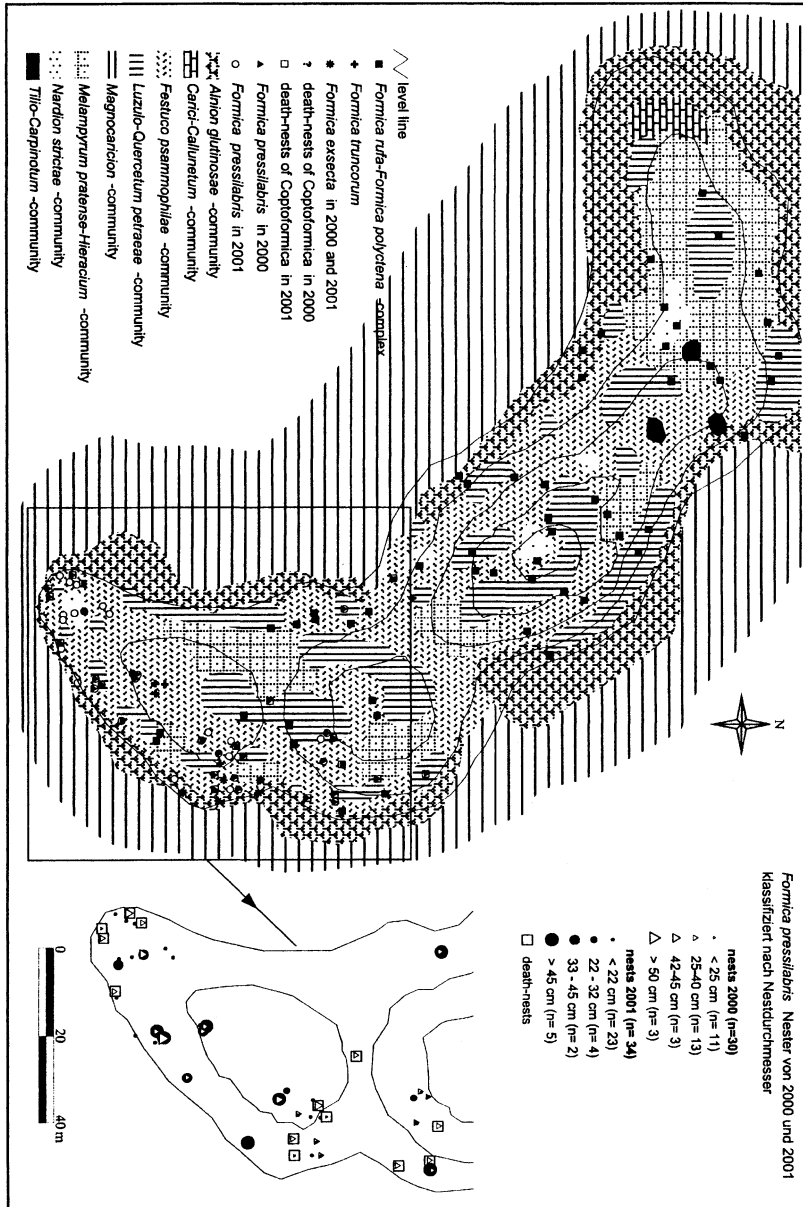


Fig. 1. Locality features and structure of the *Formica pressilabris* colony.

RESULTS

HABITAT CHARACTERISTICS AND NEST LOCATIONS

In both years, *F. pressilabris* nests were restricted to the southern part of the mineral outcrop. The south-exposed nests of *F. pressilabris* were situated in *Festuco psammophilae*- and *Melampyrum pratense-Hieracium* communities bordering on *Luzulo-Quercetum petraeae* communities (Fig. 1). Those plant communities showed 100% coverage, structural diversity was high due to species richness. Young shoots of *Populus tremula*, 10-30 cm high, grew in these plant communities, on some of them aphids and foraging *F. pressilabris* could be seen. This young shoots of *Populus tremula* were browsed by elks or cattle's. Thereby, dense vegetation such as *Calamagrostis epigeios* was reduced repeatedly, at least in the southern part of the study area and immediately over the nests, whereas in the northern part *C. epigeios* increasingly became established in spite of grazing. The effect of browsing was in irregular intervals and without spatial specificity. Before and afterwards to investigation elks and cattle's had grazed on this mineral outcrop. Therefore, all potentially aphid-infested *Populus tremula* sprouts per year was impossible assigned to GIS-Layers.

A colony of the *Formica rufa-Formica polyctena* complex predominantly colonized the northern part, few nests radiated into the southern part where they were situated below oak trees (Fig. 1). Nests of *F. truncorum* and *F. exsecta* were located immediately between nest clusters of *F. pressilabris* (Fig. 1). These *Formica* species did not change their nest locations in both years of the study, none were abandoned nor founded. Competition by these *Formica* species can be excluded, since especially the *F. pressilabris* nests located in immediate vicinity to nests of *F. truncorum*, *F. exsecta* or *F. polyctena* persisted in both years or even expanded (Fig. 1). This *Formica* species did forage on mature and ancient trees.

DEVELOPMENT OF THE VEGETATION OVER THE NESTS AND SPATIAL CHANGES OF NEST LOCATIONS

There was no correlation between vegetation density and nest diameter ($r = 0.067$) or vegetation density and nest height ($r = 0.222$). Vegetation density over the persistent nests in 2000 and 2001 did not change significantly ($p = 0.65$). Maximum vegetation density was 3800 in 2001, though in general was a decreasing trend over this nests (see Fig. 2). Mean vegetation density in 2000 was higher over the nests that were abandoned

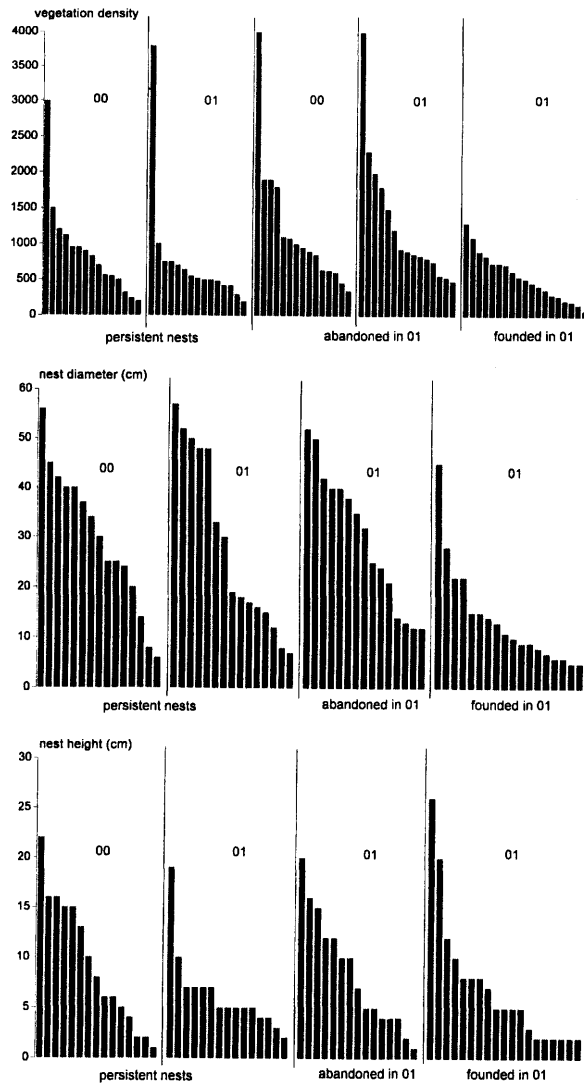


Fig. 2. Vegetation density, nest diameter and nest height of all persistent, abandoned and newly founded *Formica pressilabris* nests in 2000 and 2001.