J. Orn. 132, 1991: S. 291–295

Effect of Road Traffic on the Breeding Site-tenacity of Male Willow Warblers (*Phylloscopus trochilus*)

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Introduction

Many studies show that road traffic has a negative impact on breeding bird populations. The most eye-catching and therefore very frequently investigated effect is the injury and death of birds caused by collisions (e. g. HODSON & SNOW 1965, BERGMANN 1974). A few studies have shown that the breeding density near roads is lower than in control areas further away (e. g. VAN DER ZANDE et al. 1980, RATY 1982, REIJNEN et al. 1987), yet it is very unlikely that deaths caused by collisions are responsible for this. Mortality due to road traffic is generally too low to be a serious threat for the population size of a species (e. g. LEEDY & ADAMS 1982). We suggest that habitats along roads are less attractive to breeding birds due to one or more unknown causal factors related to road traffic. However, the verification of this hypothesis is complicated by the fact that the breeding density fluctuates more in less attractive c. q. marginal than in optimal habitats (e. g. KLUYVER & TINBERGEN 1953, GEZELIUS et al. 1984, O'CONNOR & FULLER 1985). The mere measurement of territorial density in a single year is not a suitable method to determine the quality of the habitat (WIENS & ROTENBERRY 1981).

In our study on the effect of road traffic on the density of breeding birds (for preliminary results see REIJNEN et al. 1987), we paid attention to this problem in several ways. One of them was a detailed population study of the Willow Warbler (*Phylloscopus trochilus*) (which shows a decreased breeding density adjacent to roads), aimed at determining whether road traffic makes habitat along roads less attractive. In this paper we focus on site-tenacity. Close to a road (marginal habitat) we expect site-tenacity to be lower than further from the road (optimal habitat).

Methods

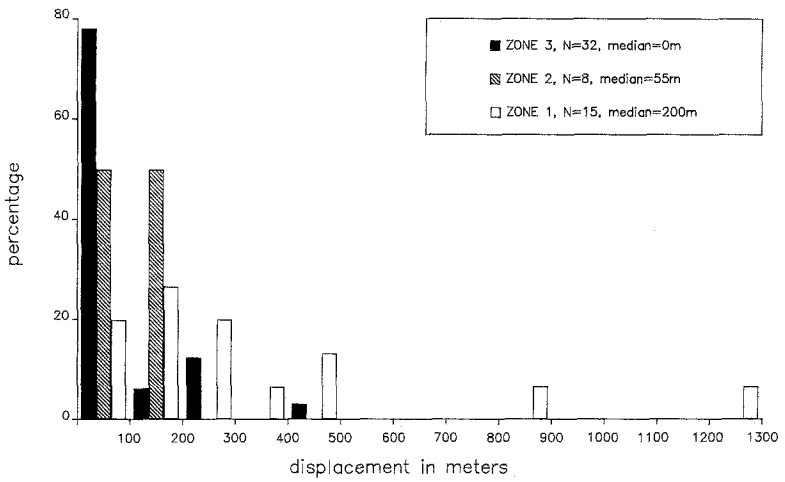
The study was carried out in an isolated area of willow plantations and some poplar woods situated along a fourlane highway (45 000 vehicles/day) near the city of Vianen in the center of the Netherlands. The area covers 154 ha and is surrounded by an extensive open meadow landscape. The willow plantations are a very attractive habitat for the Willow Warbler and the breeding density varies from 15–35 territories per 10 ha.

To study site-tenacity males were colour-ringed in 1988 and mapped in 1988 and 1989. The males could easily be mist-netted in their territories in the first two to three weeks after arrival using playback of song. We restricted the ringing activity to an area of 105 ha, but in 1989 the whole area was thoroughly searched for colour-ringed males.

For any male captured for the first time, body weight, length of body, wing, tail and bill were measured.

To analyse the data we distinguished three zones: (1) close to the road (0—200 m), (2) intermediate zone (200—400 m) and (3) a zone far from the road (>400 m). Differences in habitat features between the zones were small, because the habitat is very homogeneous.

We thank D. JONKERS and F. ANDRINGA for valuble assistance during the field work; P. OPDAM and H. A. UDO DE HAES for comments on the manuscript; and P. BOGERD for kindly permitting us to use the study area and providing free accomodation. This study was supported by a grant from the Road and Hydraulic Engineering Division of the Ministry of Transportation and Public Works.



Breeding dispersal of male Willow Warblers at different distances from the road (zone 1: 0—200 m; zone 2: 200—400 m; zone 3: >400 m).

Results

In 1988, 126 territorial male Willow Warblers (out of a population of about 160) were colour-ringed, of which 59 returned in 1989. Because the return rate of 47 % agrees with the highest levels found in other sudies (LAWN 1982, TIAINEN 1983) and no attractive habitat occurs in the surroundings of the study area, it is likely that almost all of the returning colour-ringed males were recorded. The return rate increased slightly at greater distances from the road, but the differences are not significant ($p > 0.10$, chi-square test; table).

Return rate of male Willow Warblers at different distances from the road.

distance	colourringed in 1988	returning in 1989	return rate (%)
0—200 m	44	19	43.2
200—400 m	20	9	45.0
>400 m	62	33	53.2
total	126	61	48.4

Dispersal distances between the territories occupied in 1988 and 1989, were shorter for males which settled far from the road than for males which settled close to the road in 1988 (Fig.; $p < 0.01$, KOLMOGOROV-SMIRNOV test). The number of males in the intermediate zone was too low for a meaningful analysis. The proportions of males occupying the same site (approximately more than 50 % overlap of territories) were 7 % at 0—200 m from the road, 50 % at 200—400 m and 59 % at >400 m ($p < 0.01$, chi-square test). Because of the long dispersal distances most of the males present in the zone close to the road in 1988, occupied territories at a greater distance of the road (in the other zones) in 1989. As a result in 1989 the zone close to the road was almost totally inhabitated by newly caught males.

Of the biometrical measures, wing length showed a positive significant correlation with dispersal distance ($p < 0.05$, $r = 0.28$).

Discussion

In the zone close to the road there are almost no returning colour-ringed males, so most of the males which are present are caught for the first time. Because the proportion of marked males in 1988 was very high (about 75 %) and the immigration of adult birds can be assumed to be insignificant due to the strong site-tenacity, one can suppose that most of the newly caught males in 1989 were yearlings (for a similar argumentation see BÉDARD & LA POINTE 1984, TIAINEN 1982). This is supported by the fact that the males along the road had shorter wings (yearlings have a shorter wing than older birds: HOGSTAD 1985). This means that the proportion of yearlings is much higher close to the road than further away.

A high proportion of yearlings is to be expected in a marginal habitat because older males are better competitors (due to experience or simply arrival date; RADESÄTER et al. 1987, HOGSTAD 1988). As yearlings (in 1988), the males close to the road apparently did not succeed in getting territories in the zones further away and so settled in unoccupied areas nearer to the road.

As yearlings have been found to disperse further than older birds in several species (e. g. House Martin *Delichon urbica*: RHEINWALD & GUTSCHER 1969; Chaffinch *Fringilla coelebs*: MIKKONEN 1983; Whinchat *Saxicola rubetra*: LABHARDT 1988; Collared Flycatcher *Ficedula hypoleuca*: PÄRT & GUSTAFSSON 1989), this may be an important explanation for the longer dispersal distances in the zone close to the road. One of the most important proximate reasons for the longer dispersal in yearlings could be poor breeding success in an unfavourable (marginal) habitat, as is suggested by GREENWOOD & HARVEY (1982) and later supported by several sudies (e. g. WEATHERHEAD & BOAK 1986, JAKOBER & STAUBER 1989). However, the almost complete absence of adult males close to the road in spite of a number of males successfully breeding there, suggests also a more direct influence of the road.

The results indicate that for the Willow Warbler habitats along heavily travelled roads can be considered as marginal habitats.

Summary

The breeding site-tenacity of colour-ringed male Willow Warblers (*Phylloscopus trochilus*) was studied in an homogenous area of 154 ha, which is crossed by a heavily travelled road (45 000 cars per day). Close to the road (<200 m) the dispersal of the males is much higher than for birds further away. There is also some evidence that most of the near-to-the-road males are yearlings. The differences indicate that adjacent to the road the habitat is less favourable for the Willow Warbler and can be considered as marginal.

Zusammenfassung

Untersucht wurde die Brutortstreue von individuell fabrberingter Männchen des Fitis (*Phylloscopus trochilus*) in einem 154 ha großen Gebiet, das von einer Autobahn mit regem Verkehr (45 000 Fahrzeuge pro Tag) durchschnitten wird. In der Nähe der Autobahn (<200 m) zeigten die Reviermännchen eine viel größere Dismigration als die Revierinhaber in größerem Abstand von der Verkehrstraße. Auch gab es Hinweise, daß in der Nähe der Autobahn überwiegend einjährige Männchen die Reviere besetzten. Für den Fitis kann man Habitate entlang der Autobahn als marginal betrachten.

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