Location of the transition zone of the Barn Owl subspecies *Tyto alba alba* and *Tyto alba guttata* (Strigiformes: Tytonidae)

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Abstract. The colouration of the underparts of the Barn Owl ranges in Europe from reddish-brown to white. This character, that shows a clinal variation, is thought to be a marker of subspecies identity. The subspecific identity or transitional state of a total 64 Barn Owl *Tyto alba* pairs was determined on the basis of their phenotypic characteristics. The present authors investigated the breadth of the transition zone in Hungary on the basis of the distribution of the white-chested subspecies and the transitional phenotype, and it was found to be at least 500 km wide. The width of the transition zone may result from the lack of preferences in mating pair choice. The observed pattern of phenotypic distribution is due to the marginal location of the studied population in the transition zone.

Key words: transition zone, Barn Owl.

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I. INTRODUCTION

There are six recognised subspecies of the Barn Owl in the western Palearctis (GLUTZ VON BLOTZHEIM & BAUER 1980), including the white-chested *Tyto alba alba* (SCOPOLI, 1769) in Britain, Spain, Portugal, Italy, and parts of France, and the rufous-chested *Tyto alba guttata* (BREHM, 1831) in Germany, Poland, the Czech Republic, Ukraine, and Romania. The two subspecies readily interbreed, producing fertile offspring (CRAMP 1985) that are natural hybrids (ARNOLD 1997). They interbreed in northeast France, in the Rhein valley of Germany, in the Benelux states, Switzerland, and the Balkans (CRAMP 1985). In Hungary the most common is the rufous-chested, whereas the white-chested subspecies first occurred in that country around the 1970s (KALOTÁS-PINTÉR 1984; pers. comm). More data have been appearing recently (NAGY 1998). From the authors point of view it is crucial to define what is called a subspecies. The recent distribution of the mentioned subspecies is explained by VOOUS (1950) by the postglacial areal expansion from two different refugia in SW and SE Europe. Following this hypothesis, the *T. a. alba* phenotype reached the British Isles throught Western Europe from the SW European refugium while the *T. a. guttata* phenotype expanded on the northern side of the Alps to the Channel from the SE European refugium. In the contact zones the rufous-chested phenotype tends to replace the white-chested. In this work the subspecies are defined only on the basis of underpart colouration, regardless of the origin of the in-

dividuals. It is obvious, and also evident from the geographical situation, that Hungary is part of the transition zone. However, the exact location and the extent of this zone is not clear. Presumably it is not a relatively narrow band of some hundred kilometres, as in the case of the Carrion Crow and the Hooded Crow *Corvus corone* LINNAEUS 1758, but somewhat wider. These subspecies show an assortative mating pattern (RISCH, ANDERSEN 1998). In general, praezygotic isolation, which includes mating preferences among the subspecies, leads to the reduction of hybridization and, spatially, to the narrowing of the hybrid zone. In this respect, a broad transition zone would suggest random pairing. The authors' aim was to investigate the width of the zone in Hungary.

II. MATERIAL AND METHODS

The subspecific identity or transitional status of Barn Owl pairs nesting in Hungary were determined in the nesting periods during the years 1998-2000. This species is socially monogamous, i.e. the pairs stay together during the breeding period (TAYLOR 1994). However some females and males can be polyandrous or polygynous respectively, but this phenomenon is rare and did not affect the present investigations. During previous observations (from 1989) the authors often found variations in colouring: for example the chest was reddish but the belly white, or all the underside wing feathers were white except for those in the wing joint. On the basis of these findings, 6 body parts were differentiated for the investigations (Fig. 1).
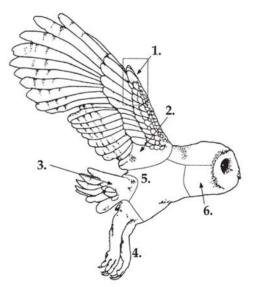

Fig. 1. Body parts as defined in our investigations: 1 – wing joint; 2 – underside wing feathers; 3 – underside tail feathers; 4 – legs; 5 – belly; 6 – chest.

The colour of body parts was categorised as follows: white, transitional, red. The body part was categorised as transitional when both red and white feathers were present. Accordingly, a bird was described as belonging to the *alba* subspecies if all six of its body parts were white, whereas a *guttata* specimen had to be rufous in all six body parts. Specimens with at least one body part differing in colour from the rest or categorised as transitional, were classified as phenotypically intermediate, because these individuals possessed coloring features of both subspecies.

It has been reported in the Barn Owl that the plumage becomes lighter from the 1st to the 2nd year of age, after which the colouration will not change (ROULIN 1999a). This is said to occur in both males and females. This feature did not affect the present studies, since it does not mean a transition from red to white, but a lightening of the red shade. In some cases the reddish colour on the borderline of the belly and chest may disappear, but this is also rare (pers. obs., ROULIN pers. comm.)

The width of the Hungarian transition zone was determined on the basis of the occurrence of white-chested and intermediate individuals, as revealed by own studies and in the literature, and plotted on the 10×10 km UTM grid map.

III. RESULTS

During the field-work extending over the entire area of Hungary representatives of both subspecies and a wide range of transitional varieties were encountered. The occurrences of white-chested and intermediate specimens collected from the literature and during the authors' own work were plotted on a map (Fig. 2).
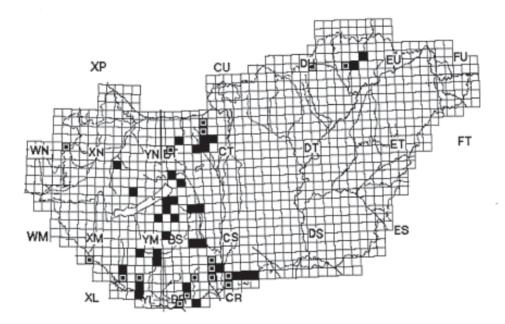

Fig. 2. Map of the study area (black squares: all Barn Owl pairs studied; black squares with white frame: white-chested subspecies and hybrid phenotypes).

On the basis of these results, the width of the transition zone seems to be at least 500 kilometres. A total of 128 individuals were studied during the three-year period (Table I). A proportion of more than 84% for the rufous-chested subspecies meets the expectations. There was no significant difference between the years with respect to the ratios of the two subspecies and the intermediate individuals (χ^2=1.595, df=4, p>0.7)

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Table 1

Phenotypic distribution of Barn Owls in Hungary (n=128)

	1998	1999	2000	Sum	Frequency (%)
Tyto alba alba	4	4	2	**10**	**7.81**
Intermediate	4	5	1	**10**	**7.81**
Tyto alba guttata	30	59	19	**108**	**84.38**
Sum	**38**	**68**	**22**	**128**	**100.00**

IV. DISCUSSION

From data available in the literature it appears that the frequency of the white-chested phenotype within the European transition zone increases towards the south and west. It reaches 75% around the middle of France (BAUDVIN 1975), whereas it is 10% in southeast Germany (GLUTZ VON BLOTZ-HEIM, BAUER 1980). Hungary is situated in the eastern area of the zone, the rufous-chested subspecies being the most frequent. Hence, the observed distribution of phenotypes was in accordance with expectation. The phenotypic distribution revealed in the present authors' case may be a consequence of the studied population not being located in the middle of the zone. This assumption is supported by the distributional charateristics prevailing in Europe.

Both white-chested and intermediate individuals were present throughout the studied area. From this fact it may be concluded that the transition zone is wide in comparison with the hybrid zones of the other bird species so far studied. The widest among the hybrid zones of the Hermit Warbler *Dendroica occidentalis* (TOWNSEND, 1837) and Townsend's Warbler *Dendroica townsendi* (TOWNSEND, 1837) in northeastern USA is ca. 120 km wide (ROHWER & WOOD 1998), whereas the distribution band of another interspecific hybrid, i.e. between the Red-legged Partridge *Alectoris rufa* (LINNAEUS, 1758) and the Rock Partridge (*Alectoris graeca*) (MEISNER, 1804) in a coastal Mediterranean area is only 15 km wide (RANDI & BERNARD-LAURENT, 1999). The widest hybrid zone known in birds is that of the Northern Flicker (*Colaptes auratus*) (LINNAEUS, 1758) with ca. 650 km at its widest section (MOORE, PRICE 1993). The other 6 known North American hybrid zones are geographically narrower (MOORE 1987; CORBIN et al. 1979; RISING 1983; BARROW-CLOUGH 1980; KROODSMA 1975 and MACK et al. 1986). The hybrid zone of the inter-subspecific hybrid between *Corvus corone corone* LINNAEUS, 1758, and *Corvus c. cornix* LINNAEUS, 1758 reaches 150 km at its widest section. These two subspecies have an assortative mating pattern (RISCH-ANDERSEN 1998). The Barn Owl does not exhibit mating preference with regard to plumage colouring (ROULIN 1999b; BAUDVIN 1975; MÁTICS et al. in press), which produces at least a 500 km wide transition zone.

The investigations by ROULIN (1999b) show however, that the males tend to prefer the more vividly spotted females, a preference that does not work the other way round. In accordance with the good genes hypothesis, this is explained by the fact that the offsprings of the vividly spotted females have a stronger immune system and a greater resistance to parasites (ROULIN et al. 2000, 2001b). In females plumage spottiness does not differ between *T. a. alba* and *T. a. guttata*, whereas it differs in males (ROULIN pers. comm., pers. obs.). The plumage colouration does not signal parasite resistance or a stronger immune system (ROULIN unpublished results cited in ROULIN et al. 2001a) but male reddish-brown plumage colouring is correlated with higher reproductive success, higher male feeding rate, and heavier heart mass (ROULIN et al. 2001a). Pairing is nevertheless random with respect to this trait, which can be explained by historic processes. The two subspecies evolved different life-history tactics and in a similar environment the correlation between colouring and reproductive success is detectable (ROULIN et al. 2001a).

The expression of plumage colouring is under genetic control and it is not affected by environmental or condition-dependent causes, which suggests that plumage colouring is a selectively neutral subspecies genetic marker (ROULIN et al. 1998). Following the criterion of the coloration of

underparts as a marker of subspecies identity there are more females belonging to *T. a. guttata* and more males to *T. a. alba.* Pairs composed of *T. a. alba* and *T. a. guttata* parents sometime produce pure *T. a. alba* and pure *T. a. guttata* offspring (pers. obs., ROULIN pers. comm.). To solve these problems, genetic analyses are required to confirm that the underpart colouring can be used to decide subspecies identity.

Presumably it is the preference for the parental phenotype that plays an important role in the preservation of subspecific features. This is said to be characteristic of several species, e. g. the northern flicker as suggested by MOORE (1995). In this case one would expect non-random pairing, because the offspring would preferably choose a mate with the phenotypic characters of one of its parents. The investigations of Barn Owls by ROULIN (1999b) also show that non-random pairing exists in the Barn Owl, but is based on spottiness and not on the underpart colouring, which is mainly used to define subspecific identity.

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