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# Impact of grassland farming intensification on the breeding ecology of an indicator insectivorous passerine, the Whinchat *Saxicola rubetra*: Lessons for overall Alpine meadowland management

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ABSTRACT

The decline of insectivorous farmland passerines has been attributed mostly to global decrease in arthropod availability, as a result of intensification of agricultural practices. The diminution of the Alpine Whinchat, once a widespread insectivorous passerine, has been ascribed to nest losses due to earlier and more frequent mowings. However, potential conjugated effects of deteriorated arthropod food availability had yet to be investigated. We compared food supply and nestling diet in intensively vs. traditionally managed grassland. Abundance and diversity of arthropods were much lower in intensive areas, where small-sized invertebrates, which do not enter nestling diet, were also predominant. Parents breeding in intensive habitats fed less biomass to nestlings than adults from traditional habitats. Nestling diet was less diverse and dominated by less profitable prey items in intensive than in traditional habitats. Feeding rate did not differ between the two habitats, but foraging distances from nest tended to be greater in intensive farmland. There were no significant differences in clutch sizes and hatching success with respect to management intensity, but fledging success was higher in traditional habitats. The recent intensification of farming practices has led to a decrease in the availability of grassland invertebrates, and of important Whinchat nestling food in particular, affecting parents' foraging efficiency and reproductive success. Conservation actions must not only reduce nest losses by postponing mowing, but should also promote grassland farming that is less detrimental to invertebrates. Dominant at the study site, organic grassland farming does seemingly not provide sufficient conditions for Alpine Whinchats.



## 1. Introduction

The populations of many farmland birds have declined severely across Western Europe over the past decades (Fuller et al., 1995; Siriwardena et al., 1998; Donald et al., 2001). This phenomenon coincided with marked changes in the agricultural landscape, especially land use intensification (Benton et al., 2002, 2003), although the actual mechanisms involved are still widely debated (Schifferli et al., 1999; Di Giulio et al., 2001; Freemark and Kirk, 2001; Vickery et al., 2001;

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Stephens et al., 2003; Chamberlain, 2004; Newton, 2004). In regard to insectivorous birds inhabiting cultivated grassland, modern agriculture may exert detrimental effects in different ways: (1) earlier mowings than in the past, which tend now to overlap with breeding season, destroy nests mechanically or render them more conspicuous to predators; (2) earlier and/or more radical mowing extirpates prey during critical nestling feeding stage; (3) denser grass cover and reduced plant species diversity, resulting from excessive fertilization, affect negatively arthropod community, availability and/or accessibility (Sotherton and Self, 2000; Di Giulio et al., 2001; Vickery et al., 2001). According to several studies, a conjunction of these factors decreases feeding efficiency and, ultimately survival, affecting in turn population density (Wilson et al., 1997; Peach et al., 1999; Brickle et al., 2000). Although this link has been established in the Grey Partridge (Potts and Aebischer, 1995), and is suspected in other insectivorous farmland birds, the evidence remains contradictory (Bradbury et al., 2003).

The Whinchat (*Saxicola rubetra)*, a ground-breeding passerine, inhabits primarily cultivated grassland, especially agricultural landscapes managed traditionally. It used to be common and widespread throughout western and central Europe (Bastian and Bastian, 1996) but drastic population declines have been documented over the past 20 years (Callion, 1993; Rheinwald, 1993; Bastian and Bastian, 1994; Yeatman-Berthelot and Jarry, 1994). Its conservation status is of concern in many European countries today (Tucker and Heath, 1994). In Switzerland, the Whinchat is red-listed as it has disappeared almost completely from the lowlands (Keller et al., 2001); it is one of the 50 priority species for species action plans in Switzerland (Bollmann et al., 2002).

Nest losses due to a shift towards earlier mowing have been described to be one key factor harming the reproductive output of Whinchats, and may hence explain their current population dynamics (Müller et al., 2005). Yet, Whinchat food availability in intensively and traditionally managed grassland have not been investigated specifically, though they might indirectly contribute to species' decline through an alteration of the reproductive performance (Labhardt, 1988; Oppermann, 1999). We studied the foraging and breeding ecology of Whinchats in the same Alpine population investigated by Müller et al. (2005), who demonstrated the negative effect of early mowing. In that area both types of grassland management are applied. We assessed first the arthropod abundance and diversity within grassland cultivated either intensively or traditionally, in order to confirm possible patterns of invertebrate food impoverishment due to the intensification of meadow cultivation (Sotherton and Self, 2000; Benton et al., 2002). Secondly, we studied nestlings' diet and adults' hunting and provisioning behaviour at 18 breeding sites, 9 in each habitat type, looking for a possible impact of farming intensification on diet profitability and energy intake. Thirdly, we attempted to identify the fitness costs possibly imposed, both on adults and broods, by the hypothesized altered food composition in intensively managed areas (Borg and Toft, 2000; Bradbury et al., 2003; Boatman et al., 2004). Poor food supplies can provoke brood size reduction and low fledging success if some nestlings suffer from starvation; they could also induce state-dependent predation risks due to conspicuous begging (Cotton et al., 1996). Parents may compensate for the negative impacts of a deteriorating environment by working harder to get the same or a reduced amount of food for their young, and so maintain a standard reproductive output (Brickle et al., 2000; Morris et al., 2001), but they would so irremediably reduce their own survival and residual reproductive value (Richner and Tripet, 1999); we accounted for these possible effects only prospectively, by analysing food provisioning frequency, prey provisioning loads and foraging distances from the nest, this in the context of optimal foraging theory (Andersson, 1981; Stephens and Krebs, 1986). Pooled together, the results of this comparative approach should lead to a more comprehensive understanding of the problems faced by Whinchats and, by extension, other insectivorous birds inhabiting cultivated farmland in a rapidly changing environment. This is an essential step to propose effective conservation measures.

## 2. Methods

### 2.1. Study area

The study was conducted from May through to July 2002 in Lower Engadin (inner Alpine valley, SE Switzerland). This area has a dry and mild summer climate (total precipitation of 271 mm in June and July 2002, for a mean ambient temperature of 15 °C). As we could not work experimentally, by applying at random a given treatment to a selected location, we had to rely on a comparative approach instead. Six sampling plots were chosen for the assessment of food abundance, three in intensively managed grassland (henceforth INT, mainly silage grass and pastures, fertilized with liquid manure) and three in traditionally managed grassland (TRAD, 70% hay meadows, 20% pastures, low input of manure if any) (Table 1). These plots were very much representative of the two management practices present. For analyses of nestlings' diet and feeding behaviour, we followed breeding pairs from four additional plots (Table 1). The discrimination of the study plots in two grassland management regimes was based upon three variables (Di Giulio et al., 2001), which enabled a clear plot separation (Table 1): (I) number of cuts per year averaged over the last 5 years (information was provided by the corresponding farmers); (II) date when 50% of the area was mown; (III) average flower diversity at the end of May, estimated from three randomly selected 1-are large plots at each sampling site in which the diversity of flowering species was assessed. Thereby, the number of flower colours present in the plots was counted by the same observer within a 15 m radius, and was used as an estimate for the actual flower diversity (Arlettaz, unpublished data). Though this method seems to be quite imprecise compared to the identification of single plant species, it yielded robust results and led to a reasonable separation of the study plot groups. The two groups also differed in other management variables (e.g., fertilizer input, see above), but since the latter were more difficult to collect and correlated with the variables measured, they were not taken into account. The TRAD-plots were located at higher altitudes than the INT-plots (1597 ± 99 vs. 1290 ± 149 m elevation, respectively), which was due to more farming intensification close to the valley bottom. However, due to the scatter of the plots with respect to management