The impact of modern dairy farming on the Whinchat: a case study in the Italian Alps

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In Italy the Whinchat breeds in the Alps and more locally, with isolated populations, along the Apennines. Its national population has been estimated at between 10,000-15,000 pairs and the species is considered to have "bad" conservation status. Since detailed studies on the potential causes of this decline at the national scale are lacking, we started a study in the Italian Alps (Trentino) to understand whether and how the dramatic management changes in the livestock system have impacted the species.
We compared Whinchat mean densities at 63 landscape plots with those reported from other Alpine studies and analysed the species' environmental preferences in relation to landscape (composition and structural elements), management (meadow fertilization and mowing calendar), topographic (slope and elevation) and spatial predictors. Shedding light on its ecological requirements, we identify possible causes of long-term decline as well as possible conservation strategies.
Mean territory density of Whinchats (0.75 territory/10 ha) was found to be lower than most other estimates obtained in the Alps. Meadow conversion into other crops and modern livestock husbandry (i.e. first mowing performed before the end of the third week of June, made possible by meadow overfertilization) have likely contributed to regional depletion of Whinchat populations, especially below 900-1000 m asl.
To date, in the Italian Alps, no specific plans or conservation projects have been implemented to counteract the Whinchat's decline; thus, targeted strategies for sustainable mountain development are urgently needed to conserve this species.

1 Introduction

The Whinchat (*Saxicola rubetra*) in Italy breeds in the Alps and more locally, with isolated populations, along the Apennines, from the Province of Pavia (N Italy) to the Sila mountains in Calabria (Brichetti & Fracasso 2008).

Its national population was estimated between 10,000 - 15,000 pairs (BirdLife International 2017, Brichetti & Fracasso 2008) and the species is considered to have a "bad" conservation status (Gustin et al 2016); in fact, it experienced a 48.9% decline between 2000-2017 (Lipu 2018), more marked at lower elevations (Brichetti & Fracasso 2008).

Although detailed studies at the national scale are lacking, the potential causes of this decline are most likely to be:
i) loss and fragmentation of breeding habitat, due to conversion and urbanization in the valley bottoms and to land abandonment at higher elevation;
ii) the modernization of traditional livestock systems;
iii) the use of pesticides;
and iv) the loss of perches (Brichetti & Fracasso 2008).

In the Italian Alps, dramatic management changes in the livestock system occurred in the last 40-50 years, and these impacted the whole bird community and specifically some species typical of hay meadows, including the Whinchat. The latter used to be common in mountain grasslands, and in particular in hay-meadows at lower elevations, where it is now almost completely absent (Assandri et al 2019b). This motivated research on this species in Trentino (NE Italy), which was recently published (Assandri et al 2019a). We report here a synthesis of the main findings of this study.

2 Study area, design, and methods

The research was performed in Trento province (NE Italy; approximatively: 45.67-46.51° N; 10.51-11.96° E). Lying within a wide altitudinal belt (65-3764 m asl), the province territory is mainly mountainous, with only 8.5% lying below 500 m, and 19.9% above 2000 m. Secondary grasslands (i.e. hay-meadows and pastures) occur, interspersed with woodland, crops and urban areas, above 250 m and more commonly between 800 and 2,000 m. Among these, hay-meadows cover roughly 200 km^2 (3.3% of the province surface; 14.8% of the Utilised Agricultural Area; ISTAT 2010) and are mostly found below 1,600 m.

From 1990 to 2010, the overall extent of hay-meadows in Trentino almost halved (Provincia Autonoma di Trento 2017), while the number of livestock units slightly increased (at least between 2000-2010), entailing a considerable increment in stocking rate (La Notte et al 2015,Scotton et al 2012). In 2010, 54,927 Livestock Units were censused in the province, spread over c.1,400 farms (La Notte et al. 2015). At low elevation (<1,500 m) rural abandonment was lower than in other areas in the Alps, and in recent years changes in meadow cover were mainly due to conversion into other crops, mostly orchards and vineyards (Marini et al 2011, Streifeneder et al 2007).

The Whinchat was surveyed along 63, 200m-long, linear transects, scattered over nine areas representative of the meadow-dominated landscapes of Trentino, between 310 and 1,565 m. Bird survey and collection of environmental variables were performed within 100 m-buffer from the transect (surface: 7.15 ha). These landscape plots became the sampling units (SU) of the study and were selected according to a stratified design: 21 in meadow landscapes that recently were partly converted into other agricultural land-use (maize, fruit orchards, vineyards, horticultural crops, and greenhouses); 20 SUs in intensive hay-meadows [species-poor meadows, highly fertilized (85-420 kg N ha-1 year-1), mown 2-3 times/year]; finally, 22 SUs were dominated by extensive hay-meadows [species-rich meadows, not or poorly fertilized (0-150 kg N ha-1 year-1), subject to only one or, rarely, two cuts per year].

Whinchats were surveyed during three visits to each SU in the 2017 breeding season (12-24.05; 13-23.06; 2-12.07).

We mapped all the first contacts with every bird inside the 100-m buffer on updated aerial photographs (scale 1:2500). Such a method is considered quite reliable and precise, because it forces the observer to pay attention to the exact

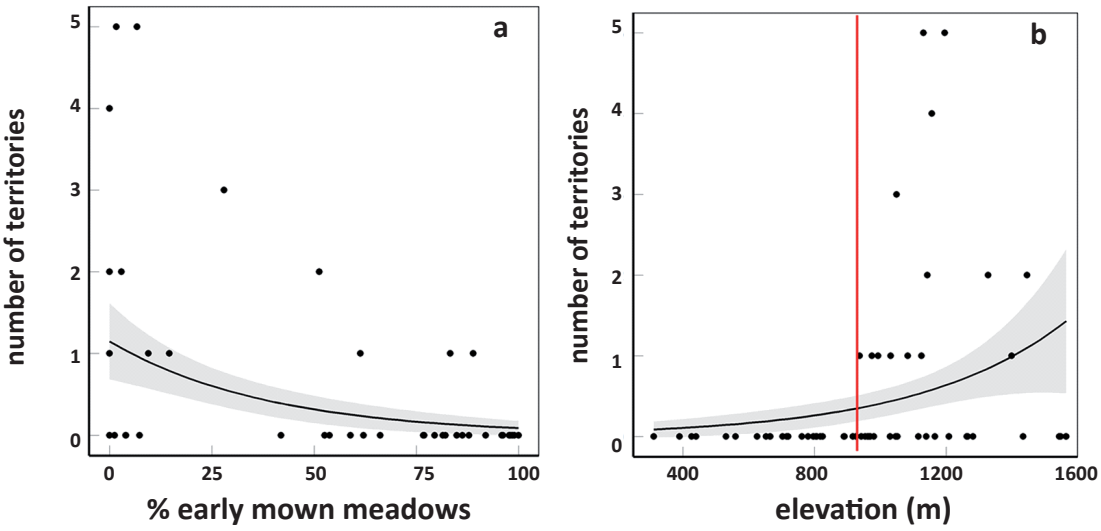

Fig. 1: Effect of the percentage cover of early mown meadows (a) and elevation (b) on the number of whinchat territories. The red line shows the altitudinal limit of the species in the meadows of Trentino. n=63.

Tab. 1: Whinchat densities at several study areas in the Alps retrieved from literature. Densities from this study are also given for comparison

Average number of territories or pairs/10 ha	Study area	Habitat	Year(s)	Reference
0,55	Malles, Alto Adige - ITALY	Hay-meadows	2011	Birrer et al 2015
0,75	Trentino (plot of converted meadow included) - ITALY	Hay-meadows	2017	present study
0,75	Alto Adige - ITALY	Wet meadows	1975	Brichetti & Fracasso 2008
1	Trentino (plot of converted meadow excluded) - ITALY	Hay-meadows	2017	present study
1.19	Valsassina, Lecco - ITALY	Hay-meadows and pastures	2010	Bazzi et al 2015
1.8	Cansiglio - ITALY	Hay-meadows	1996	Brichetti & Fracasso 2008
2	Prealps, Brescia - ITALY	-	1986	Brichetti & Fracasso 2008
2.5	Alps, Novara - ITALY	-	1963	Brichetti & Fracasso 2008
2.7	Valsesia, Vercelli - ITALY	Wet pasture	1993	Brichetti & Fracasso 2008
3.25	Vanoise - FRANCE	Hay-meadows	2004	Broyer 2009
4	Ecrins - FRANCE	Hay-meadows	2004	Broyer 2009
4.4	Goms Valley, Valais - SWITZERLAND	Hay-meadows	2011-2012	Strebel et al 2015
1.25-1.5	Varese - ITALY	Mountain heathland	´80	Brichetti & Fracasso 2008
2 - 7	Italian central Alps - ITALY	-	´70-´80	Brichetti & Fracasso 2008
3 - 4	Lessinia - ITALY	Hay-meadows	1991	Brichetti & Fracasso 2008
5 - 6	Valle d'Aosta - ITALY	-	1996	Brichetti & Fracasso 2008
0.4 - 1.26	Ossola, Piemonte - ITALY	Pastures	2000 - 2002	Brichetti & Fracasso 2008
0.4 - 1.26	Val Buscagna, Verbania, ITALY	Nardus grassland	2000 - 2002	Brichetti & Fracasso 2008
0.6 - 1.2	Mendrisotto - SWITZERLAND	-	´80	Brichetti & Fracasso 2008
2.54 - 1.48	Mendrisotto - SWITZERLAND	Hay-meadows and pastures	1987-1988 and 2009-2010	Korner et al 2017
3.9 declined to 0.5	Engadine - SWITZERLAND (plot with at least a territory present)	Pastures with shrubs	´70 and 2006	Brichetti & Fracasso 2008
4.1 and then stable	Valcamonica, Brescia - ITALY	Hay-meadows	1988 and 2000 - 2002	Müller et al 2015
4.16 declined to 2.23	Alpe Devero, Verbania (1997-2002) - ITALY	Hay-meadows	1997 to 2002	Brichetti & Fracasso 2008
8.1 declined to 3.6	Vnà, Engadine - SWITZERLAND	Hay-meadows	1988 and 2002	Müller et al 2015

location of each individual, reducing the risk of double counts of the same birds and easily avoiding those outside the plot. This is particularly true for conspicuous species, such as the Whinchat, which usually perch on exposed song-posts during the breeding season. From these counts, we obtained the number of Whinchat territories per each SU based on reproductive and territorial behaviour, interactions between individuals and simultaneous contacts (Assandri et al 2018, Broyer et al 2012). We calculated the average breeding density (number of territories/10 ha) within the sampled SUs, as an overall value as well as after the exclusion from the computation of the landscape plots with converted meadows.

At each SU we also recorded environmental variables belonging to four different sets: landscape (landcover and structural characteristics), meadow management, topography, and spatial.

For details on the field and statistical methods, the reader can refer to Assandri et al (2019a).

3 Results and discussion

We found 34 Whinchat territories (range: 0-5 per landscape plot), of which 4 were defended only in May and then excluded from subsequent analyses. The estimates of territory density obtained from this study (0.75 territory/10 ha - 1 territory/10 ha excluding SUs with converted meadow cover) are lower than the majority of other density estimates obtained in the Italian, Swiss and French Alps (Tab. 1). Although caution is necessary when comparing bird densities obtained from different studies, which are likely to have been carried out with different methods, in different habitats, and during different periods, such a comparison may be useful for a first appraisal of the species' status in the study area.

In the study area, the Whinchat was confirmed to be a pure open-habitat dweller, since it was negatively associated with isolated trees, hedgerows, and woodland cover.

Meadow conversion into other crops is a driver of habitat loss and fragmentation, which have a recognized negative effect on biodiversity (Fischer & Lindenmayer 2007; Wiegand et al 2005). Whinchats were completely absent from partly converted landscapes and this variable negatively affects the species, in accordance with similar results for the whole avian community of hay meadows in the region, supporting the evidence that partial conversion of meadows into other crops determined the reduction, and finally the disappearance, of grassland specialists from the community (Assandri et al 2019b).

Considering meadow management, Whinchat abundance was negatively associated with the cover of early mown (cut before the third week of June) meadow (Fig. 1a). For the Whinchat, the negative association with earlier mowing, which determines high levels of nest loss or direct impact on female and nestling survival, was widely recognized as a major driver of decline in a number of studies (Britschgi et al 2006, Broyer 2009, Grüebler et al 2008 and 2015, Müller et

Fig. 2: Wide extents of uninterrupted, low-intensity, flower-rich hay meadows represent the favourite habitat of the Whinchat in Trentino (NE Italy). Here, the highest densities of the species in the study area are found. Mulini Baldon, Val di Fiemme. 20.06.2017 (Photo: © G. Assandri).

Fig. 3: In Val di Non the first cut of the year is generally performed before the end of the third week of June. This has led to the almost complete extinction of Whinchat in this area. In this picture, it is also possible to see the meadow "conversion front" into apple orchards. Raina di Castelfondo (1000 m). 18.06.2017 (Photo: © G. Assandri).

al 2005). Whinchat territory abundance was positively associated with elevation (Fig. 1 b); this was expected because at higher elevation meadows are mown later in the season, allowing this grass-nesting species to complete its breeding cycle (Assandri et al 2019b, Brambilla & Pedrini 2011). In the study area, Whinchats were not found below 930 m asl. The elevation pattern is very different from the one found less than 30 years ago (1986-1995), when the species regularly bred below 1,000 m and occasionally even below 500 m (Pedrini et al 2005). Our results suggest that the recent dairy sector transformations, and the associated modifications of meadow mowing calendar, have likely turned once favourable habitats for Whinchat (and likely also for other species with similar ecological requirements) into unfavourable ones, probably wiping out entire local populations of these once common grassland species. Similar results were reported from other studies. In Switzerland, Germany, Austria and France, Whinchats almost disappeared from lowland habitats (Müller et al 2005). Broyer (2009) set at 1,200 m the upper elevation limit of the negative influence of mowing on the Whinchat in France, considering meadows located in the elevation interval of 1,000-1,200 m asl as a possible refuge for the species. The same author suggested that in the belt between 1,200 and 2,000 m, 80% of juveniles have fledged by July 10-20, whereas Müller et al (2005) at 1,160m in Engadine suggested that 75% have fledged by 30 June - 4 July. Tome & Denac (2012) found that, 22 days after hatching, 80% of the nestlings are safely fledged and are able to fly away from mowing machines; on this basis, Strebel et al (2015), in a study conducted in Valais (1350-1550 m), suggest that 80% of the nestlings are safely fledged by 6 July.

That densities recorded above 1,000 m in our study were also low appear to confirm concerns that farmland "Alpine refuges" are no longer acting as true refuges for farmland birds, and speci-

fically for the Whinchat (Archaux 2007, Korner et al 2017).

In-field meadow intensification level (based on meadow typology and hence on liquid manure disposed on meadows) seems to be less relevant than early-mowing and elevation in determining patterns of occurrence and abundance of Whinchats. However, over fertilization and mowing chronology are strictly related in a positive feedback: the use of high amounts of fertilizers increases meadow productivity and brings forward mowing, increasing the number of cuts per year, and also sustains larger numbers of (more productive) cows, which in turn produce more manure that is disposed on meadows, further increasing their productivity (Assandri et al 2019b, Scotton et al 2014). Considering two studies conducted in the Swiss Alps on Whinchat, Britschgi et al (2006) suggested that the species is negatively affected by the joint effects of mowing and arthropod reduction due to meadow intensification; Strebel et al (2015) did not find such an effect, suggesting that, in an early stage of intensification, early mowing is the most relevant threat to the species.

Finally, Whinchat abundance was likely influenced by the joint effects of landscape characteristics and management intensity, which explain the higher amount of variation (along with spatial patterns). However, most 'landscape' best predictors (i.e. number of isolated trees, hedgerow length) are influenced by agricultural management.

5 Conclusions

To date, in the Italian Alps, no specific plans or conservation projects have been performed to counteract the Whinchat decline (nor of other mountain meadow birds). Agri-environment schemes in the framework of Rural Development Programmes, designed for the maintenance of

Fig. 4: Juvenile whinchat at the margin of an extensive meadow. The first hay cut of the season has just been performed, the youngster already fledged. Altopiano del Celado (1100 m, TN). 10.07.2017 (Photo: © G. Assandri).

meadows, proved (in Italy and elsewhere) ineffective in halting the decline of species of conservation concern (Brambilla & Pedrini 2013, Broyer et al 2014). Therefore other strategies are desirable to address this conservation issue from a different perspective (Assandri et al 2019b).

Targeted plans for sustainable mountain development are urgently needed. These should include self-sustaining dairy micro-economies, based on the promotion of the local specific characteristics ("buy local"), which can enhance product quality, while promoting the maintenance of traditional landscapes, which in turn favour tourism and other recreational activities, and, hopefully, grassland biodiversity. These initiatives should be recognized, sustained (by e.g. dedicated measures in the framework of Rural Development Programmes), controlled by public authorities and guaranteed by means of dedicated quality brand and certification for the producers, highlighting the support for biodiversity and mountain traditional agriculture given by a product, which in turn justifies its higher cost.

Literature

Archaux F 2007: Are mountains refuges for farmland bird species? A case study in the northern French Alps. Bird Study 54, 73–79.

Assandri G, Bernardi A, Schmoliner A, Bogliani G, Pedrini P & Brambilla M 2018: A matter of pipes: Wryneck *Jynx torquilla* habitat selection and breeding performance in an intensive agroecosystem. J. Ornithol. 159, 103–114.

Assandri G, Bogliani G, Pedrini P, Brambilla M 2019a: Species-specific responses to habitat and livestock management call for carefully targeted conservation strategies for declining meadow birds. Journal for Nature Conservation, 125757.

Assandri G, Bogliani G, Pedrini P, Brambilla M 2019b: Toward the next Common Agricultural Policy reform: determinants of avian communities in hay meadows reveal current policy's inadequacy for biodiversity conservation in grassland ecosystems. J. Appl. Ecol. 56, 604–617.

Bazzi G, Foglini C, Brambilla M, Saino N, Rubolini D 2015: Habitat management effects on Prealpine grassland bird communities. Italian Journal of Zoology 82, 251–261.

BirdLife International 2017: European birds of conservation concern: populations, trends and national responsibilities. BirdLife International, Cambridge, UK.

Birrer S, Gasser E, Hagist D, Niederfriniger O, Unterholzner L 2015: The Heath of Malles - an irrigated landscape of high importance for meadow-breeding birds (in German with English summary). Ornithol. Beob. 4, 269–282.

Brambilla M, Pedrini P. 2011: Intra-seasonal changes in local pattern of Corncrake *Crex crex* occurrence require adaptive conservation strategies in Alpine meadows. Bird Conservation International 21, 388–393.

Brambilla M, Pedrini P 2013: The introduction of subsidies for grassland conservation in the Italian Alps coincided with population decline in a threatened grassland species, the Corncrake *Crex crex*. Bird Study 60, 404–408.

Brichetti P, Fracasso G 2008: Ornitologia italiana. Vol 5. *Turdidae - Cisticolidae*. Perdisa. Available from: https://books.google.it/books?id=2xtkPQAACAAJ&dq=ornitologia+italiana+turdidae+cisticolidae&hl=it&sa=X&ved=0ahUKEwjx0aXsyp7eAhWUhqYKHTzBBXwQ6AEILTAB (October 24, 2018).

Britschgi A, Spaar R, Arlettaz R 2006: Impact of grassland farming intensification on the breeding ecology of an indicator insectivorous passerine, the Whinchat *Saxicola rubetra*: Lessons for overall Alpine meadowland management. Biol. Conserv. 130, 193–205.

Broyer J 2009: Whinchat *Saxicola rubetra* reproductive success according to hay cutting schedule and meadow passerine density in alluvial and upland meadows in France. Journal for Nature Conservation 17, 160–167.

Broyer J, Curtet L, Boissenin M 2012: Does breeding success lead meadow passerines to select late mown fields? J. Ornithol. 153, 817–823.

Broyer J, Curtet L, Chazal R 2014: How to improve agri-environment schemes to achieve meadow bird conservation in Europe? A case study in the Saône valley, France. J. Ornithol. 155, 145–155.

Fischer J, Lindenmayer DB 2007: Landscape modification and habitat fragmentation: a synthesis. Global Ecology and Biogeography 16, 265–280.

Grüebler MU, Schuler H, Müller M, Spaar R, Horch P, Naef-Daenzer B 2008: Female biased mortality caused by anthropogenic nest loss contributes to population decline and adult sex ratio of a meadow bird. Biol. Conserv. 141, 3040–3049.

Grüebler MU, Schuler H, Spaar R, Naef-Daenzer B 2015: Behavioural response to anthropogenic habitat disturbance: Indirect impact of harvesting on whinchat populations in Switzerland. Biol. Conserv. 186, 52–59.

Gustin M, Brambilla M, Celada C 2016: Stato di conservazione e valore di riferimento favorevole per le popolazioni di uccelli nidificanti in Italia. Rivista Italiana di Ornitologia 86, 3–36.

ISTAT 2010: Caratteristiche strutturali delle aziende agricole. 6° Censimento Generale dell'Agricoltura. 24 ottobre 2010. Nepi (Italia)

Korner P, Graf R, Jenni L 2017: Large changes in the

avifauna in an extant hotspot of farmland biodiversity in the Alps. Bird Conservation International 28, 1–15.

LIPU 2018: Farmland Bird Index nazionale e andamenti di popolazione delle specie in Italia nel periodo 2000-2017.

Marini L, Klimek S, Battisti A 2011: Mitigating the impacts of the decline of traditional farming on mountain landscapes and biodiversity: a case study in the European Alps. Environmental Science & Policy 14, 258–267.

Müller M, Spaar R, Schifferli L, Jenni L 2005: Effects of changes in farming of subalpine meadows on a grassland bird, the whinchat (*Saxicola rubetra*). J. Ornithol. 146, 14–23.

La Notte A, Marongiu S, Masiero M, Molfetta P, Molignoni R, Cesaro L 2015: Livestock and Ecosystem Services: An Exploratory Approach to Assess Agri-Environment-Climate Payments of RDP in Trentino. Land 4, 688–710.

Pedrini P, Caldonazzi M, Zanghellini S (ed) 2005: 80 Studi Trentini in Scienze Naturali, Acta Biologica Atlante degli Uccelli nidificanti e svernanti in provincia di Trento. Museo Tridentino di Scienze Naturali, Trento.

Provincia Autonoma di Trento 2017: Italy - Rural Development Programme (Regional) - Trento. 2014-2020. Version 2.1.

Scotton M, Pecile A, Franchi R 2012: I tipi di prato permanente in Trentino.

Scotton M, Sicher L, Kasal A 2014: Semi-natural grasslands of the Non Valley (Eastern Italian Alps): Agronomic and environmental value of traditional and new Alpine hay-meadow types. Agriculture, Ecosystems and Environment 197, 243–254.

Strebel G, Jacot A, Horch P, Spaar R 2015: Effects of grassland intensification on Whinchats *Saxicola rubetra* and implications for conservation in upland habitats. Ibis 157, 250–259.

Streifeneder T, Tappeiner U, Ruffini FV, Tappeiner G, Hoffmann C 2007: Selected aspects of agro-structural change within the Alps a comparison of harmonised agro-structural indicators on a municipal level. Revue De Geographie Alpine-journal of Alpine Research 95, 41–52.

Tome D, Denac D 2012: Survival and development of predator avoidance in the post-fledging period of the Whinchat (*Saxicola rubetra*): consequences for conservation measures. J. Ornithol. 153, 131–138.

Wiegand T, Revilla E, Moloney KA 2005: Effects of habitat loss and fragmentation on population dynamics. Conserv. Biol. 19, 108–121.

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