Habitat requirements and population development of the Whinchat (*Saxicola rubetra*) in the Styrian Ennstal (Austria)

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Habitatanspruch und Populationsentwicklung des Braunkehlchens (*Saxicola rubetra*) im Steirischen Ennstal (Österreich)

Die Population des Braunkehlchens (*Saxicola rubetra*) im Mittleren Ennstal (Steiermark) galt bis vor wenigen Jahren als eine der stabilsten in ganz Österreich. Die fortschreitende Intensivierung der Wiesenbewirtschaftung der letzten Jahrzehnte gab Anlass zu einer flächendeckenden Erfassung der Braunkehlchenvorkommen in den Europaschutzgebieten von Admont bis Gröbming und dem Raum Bad Mitterndorf. Auf Grundlage von verschiedenen Erfassungen aus den Jahren von 2003 bis 2015 wurden die alten Fundpunkte und deren Umgebung auf Braunkehlchenvorkommen kontrolliert. Ergebnis der Kartierung ist ein Rückgang der Reviere um 90 % im zentralen Europaschutzgebiet („Ennstal zwischen Liezen und Niederstuttern"). Im ganzen Untersuchungsgebiet konnten 2016 insgesamt 14 Reviere festgestellt werden.
In den besetzten Revieren (unterschieden wurde zwischen solchen mit und solchen ohne Bruterfolg) und auf Kontrollflächen, auf denen bei vorjährigen Erhebungen noch Reviere festgestellt werden konnten, wurden Habitatparameter erhoben, die potentiell einen Einfluss auf Revierwahl und Bruterfolg haben könnten. Auf den Flächen mit Bruterfolg lagen eine signifikant höhere strukturelle Vegetationsdiversität und Anzahl an diesjährigen überstehenden Pflanzenstängeln sowie ein höherer Grad an Bodenunebenheit vor. 50 % der Gelege wurden durch Mahd zerstört, was zeigt, dass im Gebiet der Zeitpunkt des ersten Mahdtermins der entscheidende Faktor für Bruterfolg ist.
Des Weiteren wurde das Verhaltensrepertoire der Braunkehlchen zum einen auf einen möglichen Einfluss auf den Bruterfolg analysiert und zum anderen auf die Ansprüche in der Nutzung von Warten. Das Verhalten der Individuen mit Bruterfolg unterschied sich nicht in relevanter Signifikanz von solchen ohne Bruterfolg. Es wurde ein positiver Zusammenhang zwischen Verfügbarkeit und relativer Nutzungsdauer für die Wartentypen Zaundraht und heurige Vegetation festgestellt.
Auf Grundlage dieser Untersuchung sowie anderer Schutzprojekte wurden Maßnahmenvorschläge erstellt und im Rahmen von Schutzprojekten umgesetzt. Monitoringergebnisse liegen bisher von 2016 bis 2018 vor.

1 Background

Until a few decades ago, the abundance of meadow birds, such as the Whinchat (*Saxicola rubetra*), was taken for granted. Recently, however, there has been a dramatic decline in Whinchat breeding abundances throughout Central Europe, leading to the disappearance of entire populations (Bastian & Feulner 2015). The decline in breeding abundance of the Whinchat in Austria is subject to regional differences. Due to the intensive agricultural use of meadows in the lower altitudes, the Whinchat occurs almost exclusively in higher alpine regions. From 1998 to 2014, the Styrian population declined by about 40% (BirdLife Österreich – Landesgruppe Steiermark 2015), which corresponds to the overall Austrian trend of 20-40 % (BirdLife Österreich 2014). The most recent estimates for Styria indicate 50-100 breeding pairs (Uhl et al 2017).
The rapid decline of the Whinchat populations necessitates the introduction of measures to protect habitats. In order to take appropriate protective measures, knowledge of the factors responsible for the decline of populations is crucial. The population in the Mittleres Ennstal was considered to be one of the stable populations in Styria, but a decline was assumed here due to an increasingly intensive meadow management (BirdLife Österreich – Landesgruppe Steiermark 2015). Prior to this study, however, there had been no recent survey of the condition of this population.
In the context of a master thesis, the Whinchat population in the Styrian Ennstal (Austria) was examined for its current condition and habitat requirements (Völsgen 2017). Subsequent projects enabled continued monitoring and the implementation of protective measures. The present study provides information on the current situation of the Whinchat populations in the

protected areas of the valley area of this region. As already mentioned, the rapid decline of the Whinchat populations is closely related to habitat requirements (Bastian & Bastian 1996). In order to identify important habitat parameters for the population in our study area, that may have contributed to the local decline of the species, the present study compared current breeding areas with formerly populated areas. The selection of habitat parameters is based on species-specific characteristics. It is assumed that there is a correlation between successful breeding and a high number of perches, high vegetation density, vegetation structure and ground flatness. Their behaviour in their breeding territories provides indicators of the habitat requirements of Whinchats. Differences between territories with and without breeding success and control areas in different habitat types were investigated. Habitat requirements were identified using information gathered on site selection and breeding success, various habitat parameters and behavioural observations in the breeding territories. Based on these requirements, adapted protective measures were developed and have been implemented since 2017. The survey of Whinchats in the area with main breeding sites between Liezen and Niederstuttern was continued in 2017 and 2018.

2 Methods

The study area lies in the Styrian Ennstal valley and the Bad Mitterndorf area between Admont and Gröbming at an altitude of 643 m (Wörschach) to 800 m above sea level (Bad Mitterndorf). The landscape of the valley floor is characterized by meadows for the dairy industry. Most of the meadows are mown 3 to 5 times each year. Nevertheless, due to its high biodiversity, the Ennstal belongs to the eight most species-rich regions in Austria (Dvorak et al 1993). The mosaic of different habitats, including wetlands, cultivated land and forest communities, supports large numbers of bird species (Amt der Steiermärkischen Landesregierung 2007). The study area is located within or near to protected areas.

2.1 Survey

2016

In the study, 212 known breeding sites of Whinchats were surveyed. These were identified from

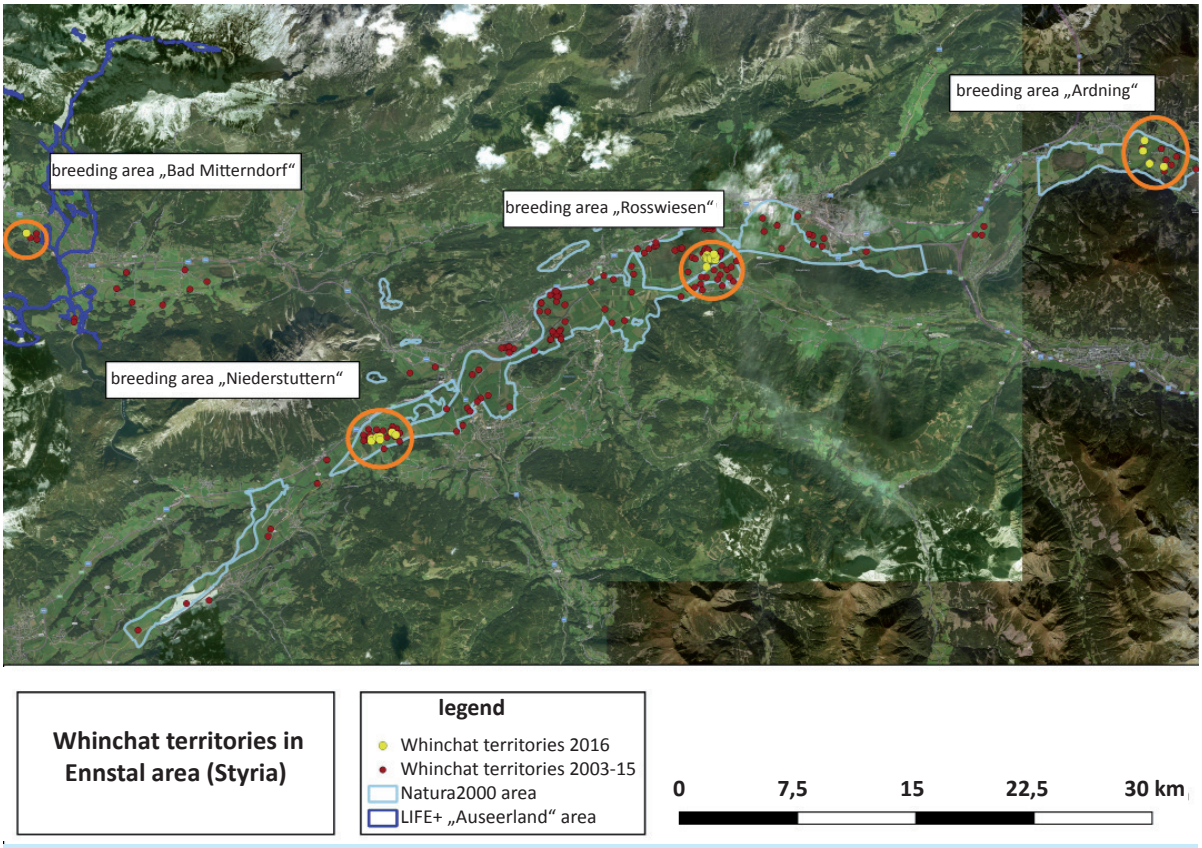

Fig. 1: Whinchat breeding areas in the Ennstal area.

Tab. 1: Number of Whinchat territories and successful broods in the study area.

Breeding areas	No. of territories 2016	Successful broods	No. of territories 2017	Successful broods	No.of territories 2018	Successful broods
Bad Mitterndorf	1	0	0	0	0	0
Ardning	3	1	2	2	-	-
Niederstuttern	5	1	2	1	3	1
Rosswiesen	5	4	6	6	4	4
Irdninger Moos	-	-	-	-	1	0
Total	14	6	10	9	8	5

various surveys carried out in different parts of the study area in 2003-2005, 2009, 2010 and 2015. Based on the observations from three survey rounds, and following the method of Bibby (1995), paper territories were constructed. The boundaries of these territories were defined as precisely as possible on the basis of the locations of male birds.

2017 to 2018

Surveys of Whinchats continued in 2017 in the same study area. In the year 2018, the study area was restricted to the main breeding areas between the Rosswiesen (Wörschach) and Niederstuttern.

2.2 Recording of habitat parameters

The following parameters were recorded in the territories and on an identical number of control areas: proportion of last year's tall herbaceous plant stems; proportion of this year's tall herbaceous plant stems; number of fence posts; fence wire in metres; number of trees and shrubs; haystacks; and ground flatness in microrelief (Fischer et al 2013). Additional parameters were recorded in two randomly selected 4x4m sample areas per territory: vegetation height, ground vegetation density (Bibby 1995), structural vegetation diversity (Fischer et al 2013). The habitat parameter „structural vegetation diversity" is used as a measure for the diversity of plants and their varying growth form and height.

2.3 Behavioural observations

Observations of the whereabouts and behaviour of the Whinchats were carried out. With the help of a dictaphone, activity protocols were drawn up that were accurate to the second and relate behaviour to the corresponding location in territory.

3 Results

3.1 Survey

2016

In the first round from the beginning to mid-May 2016, 99 Whinchats were observed in migratory groups, pairs or as single birds. The first breeding evidence in the form of warning birds was noted on May 29th, the last warning calls on June 18th. Feeding birds were first seen on June 3rd.
In all, 14 territories were found in 2016. However, two of these were occupied by unpaired males. Breeding was proven in 11 territories and successful in at least six of these (Tab. 1). The territories were spatially clumped in four breeding areas. Territory sizes varied between 0.96 and 6.95 ha with an average size of 2.91 ha (standard deviation σ 1.66 ha).

2017 to 2018

After an unsuccessful brood in 2016, no Whinchat returned to the former breeding area in Bad Mitterndorf in the following years. In Ardning in 2017, a territory was established at a site where there had been none in 2016. With the exception of a territory on a meadow owned by a nature conservation NGO (Naturschutzbund Steiermark), all breeding pairs in Niederstuttern failed due to the early mowing dates. In the Rosswiesen meadows, also owned by the NGO, the number of territories was largely stable during the three years of the study. One solitary male established a territory in the Irdninger Moos in 2018 (Tab. 1).

3.2 Habitat parameters

A Kruskal-Wallis ANOVA showed that territories differ significantly in the variables "structural vegetation diversity", "proportion of this year's tall herbaceous plant stems", "number of fence posts", "vegetation density" and "ground flat-

ness“. Haystacks were used with negligible frequency.

Mann-Whitney-U-tests showed significances between all three groups (territories with and without breeding success and control areas) only in the habitat parameter “structural vegetation diversity“. For the parameter “proportion of this year‘s tall herbaceous plant stem“ there are significant differences found between the areas with breeding success and control areas, as well as with the areas without breeding success. The “number of fence posts“ and the “vegetation density“ differ significantly between the control areas and the areas without breeding success.

The vegetation density was 100% at the time of recording on all occupied territories, while the density varied greatly on the control areas. The values for the flatness of the ground were high in all territories with breeding success, which corresponds to uneven ground. A significant difference between territories with breeding success and the control areas was found, but not with the areas without breeding success. The values of the habitat parameter “number of fence posts“ vary strongly in areas without breeding success, whereas they are very low in the control areas and slightly higher in the territories with breeding success. The vegetation height in the territories with and without breeding success has generally high values, whereby only the territories with breeding success differ significantly from the control areas.

Significantly more structures in the vegetation were found in the meadows with extensive mowing management compared to intensively managed meadows ($H2 = 31.219$, $p < 0.001$). There are significantly more fence posts ($H2 = 8.167$, $p < 0.001$) and fence wire ($H2 = 12.541$, $p < 0.001$) on territories in intensively managed meadows than in those on extensively managed meadows.

3.3 Behavioural observations

The visualization of the similarity of the male Whinchats` behaviour repertoire during reproductive time by MDS (Multidimensional scaling) ordination shows clear differences only between unpaired and mated males, but not between mated males with and without breeding success (Fig. 2). For females also no effect between individuals with and without breeding success could be proven.

Three calculated linear mixed models, which test for correlations between availability of perch types and relative duration of stay, showed a positive relationship between availability and relative duration of stay for the perch types “fence wire” ($F1.35 = 37.433$, $p < 0.001$) and “this year‘s vegetation” ($F2.34 = 3.739$, $p = 0.034$), but not for the perch type “fence post” ($F1.35 = 0.505$, $p = 0.482$).

4 Discussion

4.1 Whinchat population in the study area 2016 to 2018

The comparatively large number of Whinchats in the first survey in May 2016 is explained by a high proportion of migrating birds. The sites used were mainly areas that later turned out to

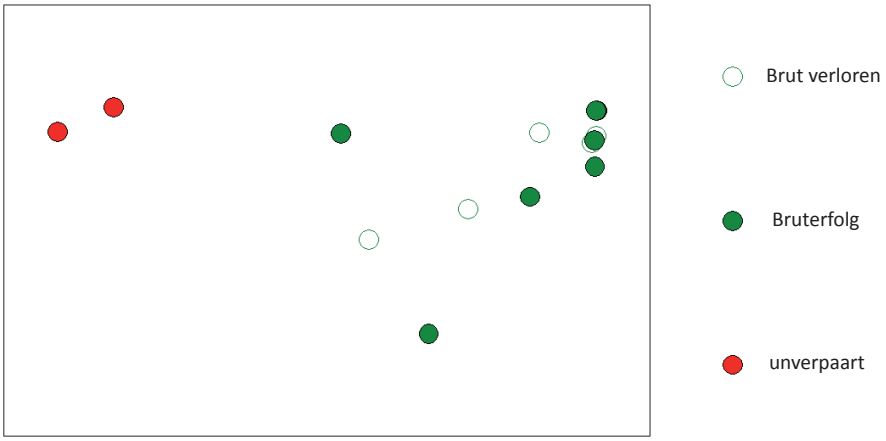

Fig. 2: Similarity of the behavioural repertoire during reproductive phase visualised by MDS ordination for unpaired males and males with and without breeding success (stress = 0.01).

Fig. 3: Whinchat on a fence post in a diverse extensively managed meadow in late summer with sufficient insect supply, Rosswiesen (Photo: © H. Kolland).

be the breeding areas, as well as areas where territories in the past were located. It remains unclear whether the Whinchats wanted to establish a territory in these areas but moved on, e.g. due to disturbances, or whether the areas were suitable only as resting areas, but no longer as breeding habitats, due to changes in the environment. Despite the agricultural intensification that has taken place on the Ennstal meadows in recent decades, the area still provides important resting areas for Whinchats and other migratory birds (BirdLife Österreich – Landesgruppe Steiermark 2015).

The breeding abundance of the Whinchats in the Ennstal valley area has declined significantly over the past decades. As early as 2007, the management plan for the Natura 2000 reserve in the study area criticised the poor state of conservation of Whinchats. The Whinchat population in the Ennstal Valley in 2007 was reported to be up to 130-150 breeding pairs (Amt der Steiermärkischen Landesregierung, FA 13 C 2007). With 10 breeding pairs in 2016, the population in the Natura 2000 reserve has declined by more than 90 %. Since Whinchats have a high site fidelity, non-occupation of former territories usually indicates an unfavourable change in the habitat or fewer recurring individuals (Bastian & Bastian 1996). The habitat changes associated with progressive intensification in agriculture can have a delayed impact on population sizes (Grüebler et al 2015). The danger of the extinction of the Ennstal Whinchat population seems very real with such dramatic declines. The shrinking of such residual populations can be intensified by positive rebound effects. Thus, smaller populations react more sensitively to natural influences such as predation and unfavourable weather (Uhl 1996).

4.2 Behavioural observations

Differences in the behaviour repertoire of male Whinchats are due to their mating status. Horstkotte (1962) describes how, at the beginning of the breeding season, mated males are busy searching for food, observing the female during breeding and delimiting their territory, while unmated males sing almost continuously. The similarity in behaviour between the mated individuals with and without breeding success shows that the influence preventing success must come from other origins than in behavioural patterns.

A major problem for Whinchats due to the loss of structures in the landscape, such as pasture fences, becomes clear in the utilisation patterns of perches. Fence wire is very often used as an

artificial perch. A study from Lower Saxony (Germany) showed 35 % fence wire in the number of perches used (Richter 2015). According to the predicted values of the mixed linear model, there is a strongly positive correlation between the perch type fence wire and its availability. With an availability of 200 m of fence wire in the territory, the percentage duration of stay would be 20%. On extensively managed meadows, tall herbaceous plant stems are clearly more important than fences. In intensively managed meadows, the abundance of natural perches is smaller, which is why artificial perches play an important role here. Grasses are hardly used, because Whinchats require a certain perch stability (Pudil & Exnerová 2015). In a structurally rich, extensively managed meadow Whinchats find a richer supply of insects, which they often hunt in shallow flights from perch to perch (Riegel 2002). Although fence posts were frequently used as perches, a positive correlation between increased use and increased availability was not found in this study. In order to improve the availability of perches on intensively used meadows, the use of fences or fence posts is a first essential measure to improve the habitat.

4.3 Important characteristics of Whinchat areas

The Whinchat only chooses areas as breeding habitats in which there are sufficient perches to use as resting spots, for hunting, as a singing station or to overview the nest (Bastian & Bastian 1996). A study from Hanság (Burgenland) showed that the vegetation structure in the herb layer in extensively managed meadows provides sufficient perches for Whinchats (Schuster 1992). The presence of plant stems is an indicator of extensive mowing management and is therefore also related to food availability. In the present study, the proportion of this year‘s tall herbaceous plant stems in territories with breeding success was significantly higher than in the control areas and thus a clearly relevant factor in protection management.

The proportion of last year’s tall herbaceous plant stems plays an important role in the territory selection in spring (Schuster 1992, Horch et al 2008). These are mostly dried stems of tall perennials that are used as singing and hunting perches while establishing the territory, when this year‘s vegetation does not yet offer tall stems (Schuster 1992). A comparison of the proportion of last year’s tall herbaceous plant stems between the occupied territories and the control areas showed no significant difference in the present study. The reason for this is most probably the generally very small number of last year‘s tall plant stems in vegetation in the entire study area. If insufficient natural perches are available, as at the beginning of the vegetation period, artificial perches, such as fences, are of greater importance (Fischer et al 2013). There are no fence posts on the control areas in the present study, and the number of fence posts in territories with successful breeding is also low. Here, however, the Whinchat finds perches in the vegetation structure. Compared to territories on extensive meadows, territories on intensive meadows with poorer structures had a larger number of fence posts and fence wire. This confirms the research of Fischer et al (2013) pointing out that artificial perches have a high relevance as substitutes for natural perches. The significant difference in the number of fence posts between territories without breeding success and control areas indicates the relevance of artificial perches at the time of territory selection, especially in structure-poor meadows. A combination of fence posts and late mown meadows is therefore essential for protection measures. Care should be taken when taking measures to make areas attractive as breeding habitats for Whinchats. If mowing management is not adapted, such areas may turn into ecological traps (Bastian & Bastian 1996).

The abundance of plant species in meadows plays an important role in the selection of the territory. Meadows with an average number of 8 to 11 characteristic species are disproportionately often chosen by the Whinchat as a hunting ground (Oppermann & Süsser 2015). These findings are also confirmed in the present study: Whinchat territories have a significantly higher structural vegetation diversity than the control areas; and territories with breeding success differ significantly from territories without breeding success. The importance of a high vegetation diversity for the Whinchat is associated with higher insect abundance (Oppermann & Süsser 2015). In order to achieve greater plant diversity, it is essential to avoid fertilisation and extensify mowing management. In addition, mowing with bar mowers is recommended in comparison to rotary/disc mowers (Pfiffner et al 2006).

Whinchats build their nests hidden in grass tussocks, hollows or dense grass patches and moss on the ground (Bastian & Bastian 1996). In modern agriculture, such irregularities are considered disturbing and often removed. The ÖPUL (contractual nature conservation) measure NPA04 was therefore implemented in the „Lungau Species Conservation Project“ for the Whinchat, which prohibits the levelling of dips and ground unevenness (Teufelbauer et al 2012). Fertilization prevents the formation of dense vegetation in the herb layer (Bastian & Bastian 1996). The present study has shown a significant difference in soil flatness and vegetation density between Whinchat territories and control areas, which suggests measures to prohibit soil levelling and fertilization.

Fig. 4: Whinchat using a characteristic plant in the Ennstal area, a Siberian iris (*Iris sibirica*), as perch (Photo: © H. Kolland).

High structures, such as trees, shrubs and haystacks, were not abundant in the territories, nor did they have a significant effect on the choice of territory or breeding success.

4.4 Management recommendations for Whinchat in the Ennstal valley and their implementation

Even though the Whinchat is found in such large populations worldwide that it is listed as of „Least Concern" on the IUCN Red List, the rapid decline in Central Europe and thus also in Austria is nevertheless alarming (BirdLife International 2016). As a characteristic meadow bird, the collapse of numerous Whinchat populations points to the poor current state of grassland, whose overall management is hardly compatible with the survival of wild animals.

Therefore, the aim is to integrate measures into meadow management that enable the coexistence of economic grassland use and space for biodiversity. On areas such as the Rosswiesen meadows, which are owned by a Nature Conservation NGO, the implementation of management measures is easily feasible, as there is no need to make profit here. Protecting territories or entire habitat networks in agricultural landscapes however is a challenge, not only in raising funds for contractual nature conservation but also in negotiations with farmers whose most fertile meadows lie in the valleys. As a background to applied conservation measures on the meadows, political decisions as well as alternative forms of economic use are needed.

Only a breeding habitat network can ensure the survival of the Whinchat in the Ennstal in the long-term. It seems natural to start with the few existing breeding areas; to preserve and optimize them (Horch et al 2008). The areas used as breeding areas in 2016 and the surrounding areas are to be brought into a state that will enable Whinchats to breed successfully and survive until the young are fully fledged. The management of the breeding areas is based on an already proven system from the Lungau, which consists of a combination of meadow strips with fence posts and adjacent meadows that will be mown late (Eichberger et al 2013, W. Kommik verbally).

In order to ensure a sufficient food supply in breeding areas fertilisation or application of pesticides is not recommended at all or at least until after the first mowing date. For the breeding areas, a combination of alternately mown meadow stripes with artificial perches and late mown meadow areas is proposed. However, later mowing times are often difficult to implement for financial reasons, so that the limited possibilities available must be considered when applying such measures. In order to achieve the goal of stabilising the Ennstal population, a contractual nature conservation scheme for meadow birds was developed in 2018, handled by the Styrian nature conservation department. This support programme provides compensation payments for ecologically high-quality areas with relevance for meadow breeders. In this way, later mowing times, the renunciation of fertilisation and the retention of structures such as meadow edge stripes can be realised. Whenever possible, the Naturschutzbund Steiermark purchases and rents new parcels that help to enlarge the habitat network.

At best, the first mowing date should not be before July 15th (Schneider & Schulze 2015), but, depending on the willingness of the farmer, it is possible from June 25th (Reuter & Jacob 2015). Nestlings are more likely to fledge by a later mowing date. In addition, a later mowing date increases the structural vegetation diversity in these areas and thus the food supply (Oppermann & Süsser 2015). Two meadow strips per meadow should be left standing during summer and one each year until the second mowing in the following year. So, each spring there will be a meadow strip left. The plants can complete an entire vegetation cycle, which means that there are stems that can be used as hunting perches and more insects are available.

These natural vegetation perches in the meadow landscape promote the selection of territory after arrival from the winter quarters (Horch et al 2008). In order to increase the structural diversity of vegetation in the newly established meadow strips, autochthonous seed mixtures are introduced, especially in intensively managed meadows with little structure. The seed mixtures are sown without ploughing the soil to prevent conflicts regarding the status (arable or meadow). Fence posts are placed in these meadow strips. In order to reduce disturbance, the meadow strips should not be situated near to frequently used roads and paths. Distances to woods or buildings of 30-60m should be maintained as these features have a deterrent effect on Whinchats (Bastian &

Bastian 1996, Feulner & Förster 1995).
Artificial perches of 60-130cm, such as fence posts, are to be set up in the meadow strips or, if already existing, preserved. The implementation of these measures showed that a farmers' willingness to set fence posts is rather easy to evoke, but not fence wires. According to Oppermann (2015), optimal habitats have at least 25 control points/100m^2. This high density is difficult to achieve with fence posts. From 2018 the so-called „over-stimulation method" (Siering & Feulner 2017) has been applied on former Whinchat territories to promote reintroduction. With alternative perches, such as bamboo sticks or willow rods, the number of perches can be increased at little expense (Siering & Feulner 2017, Scheinpflug 2017). The long-term stability of such perches, on the other hand, is lower than that of fence posts. Occasional bushes can also be planted as perches, from which the Red-backed Shrike (*Lanius collurio*) and the European Stonechat (*Saxicola rubicola*) also benefit (Schuster 1992). At the same time, meadow strips are promoted on these areas and attention is paid to a Whinchat-friendly mowing management. No reoccupation of former territories was observed in the first trial year.
Existing landscape structures, such as old fences, haystacks or bushes, which serve as perches for Whinchat and other perch hunters (e.g. Red-backed Shrike, Redstart *Phoenicurus phoenicurus*), were recorded in all territories and should be preserved.
Due to the existence-threatening small size of the populations in the study area, nest protection is important and feasible in the coming years. This requires regular and frequent monitoring and agreements with the farmers. Around the nest location, 1000m^2 are to be saved from mowing as an immediate measure (Horch et al 2008).
Temporary wet meadows and areas with reeds, such as found on the Rosswiesen, have become very rare due to drainage and should not be filled in or further drained. Whinchats also need areas with patchy vegetation for hunting (Bastian & Bastian 1996). Reed-breeders, such as the Reed Bunting (*Emberiza schoeniclus*), and resting waterfowl also benefit from this measure (Dvorak et al 1993).
Another important instrument is public relations work. The knowledge about meadow birds and their needs and a consequent acceptance by local residents is necessary for a long-term conservation programme. Information about the existence of meadow breeders and their habitat requirements should be aimed particularly at farmers. Here, information through local newspapers is not sufficient. Face-to-face events in an informal environment have proven to be the most suitable framework for raising awareness of this topic and for winning farmers for conservation projects.
Any crop losses are financed by compensation payments via ÖPUL (subsidies e.g. contractual nature conservation) or the newly introduced meadow breeders contractual nature conservation for farmers without ÖPUL participation. In the long term, it would be ideal to extensify the farming management for the production of organic pasture milk in order to give the Whinchat and thus wildlife a place in the meadows.

5 Literature

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