Zur Verfügbarkeit von Invertebraten als Nahrungsgrundlage für das Braunkehlchen in der Bad Stebener Rodungsinsel (Oberfranken, Deutschland)

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Availablility of invertebrates as food for the Whinchat in the vicinity of Bad Steben (Upper Franconia, Germany)
The Whinchat (*Saxicola rubetra*) is “critically endangered” in Bavaria (Rudolph et al 2016). While the ADEBAR survey of 2005-2009 resulted in 1200 – 1900 breeding pairs (Rödl et al. 2012), the last survey (2014-2015) found only 455 BP in Bavaria.
An important (former) population hotspot in Bavaria and Franconia is the farmland area around Bad Steben, Oberfranken. The local population was about 50 – 60 pairs in the 1990ies, but declined to less than 10 pairs in this decade. The main causes are changes in agricultural land use and management: grassland usage was intensified (earlier and more frequent mowing, pesticides, fertilizer), or grassland was ploughed, lesser parts got lost by usage as building land and by reforestation.
This project focuses on the question, if reduced availability of food might be a reason for the population decline. We studied the invertebrates densities of three wet grassland habitats within whinchat territories (sites No 1, 2, 3) and three sites utilised by whinchats in the past but without breeding birds at the moment (sites No 4, 5, 6; see Tab. 1).
We collected invertebrates during nine periods (= FP), each lasting 14 days, in 2016 and 2017 (see Tab. 2). Invertebrates were sampled by a malaise trap and a biocoenometer on each site. The malaise trap (Fig. 1) collects flying insects mainly, whereas the biocoenometer (Fig. 2), equipped with a pitfall trap on ground and a trap on top of the tent, collects all species living resp. emerging within an area of 1 x 1m².
For data analysis, we distinguished between 17 invertebrate groups and counted the numbers of individuals (with body length between 1 and 11 mm) collected by the traps. In total, we gained more than 147.000 animals. 94.3% were collected by Malaise traps, 3.4% by pitfall traps and 2.3% fell into the biocoenometer top traps.
56.4% were Brachycera flies, 23.8% Nematocera flies, 4.3% Aculeata, 3.0% beetles, 2.8% moths and butterflies, 2.4% plant-lice and 2.0% leaf- and planthoppers. All other groups represented less than 2% of the total yield (see Tab. 3).
Insect densities differ stronger between collecting periods than between sites. The highest abundances were recorded in the second half of May. The number is reduced by 38.5% in June. This is most likely caused by mowing of the environs. Insect densities increase slightly in July; the lowest numbers were recorded end of August.
Biocoenometer data also show distinct fluctuations between sites and collecting periods, but we could not found any correlations to the presence/absence of the whinchat.
Due to the considerable general decline of insect biomass in the last decades (e.g. Hallmann et al 2017), we assume, that reduced availablility of food is a crucial factor influencing whinchat population decline on a landscape level.
The improvement of known territories might be a suitable mitigation measure for a short term stop of further population loss, but in the long run we recommend the diversification of land use types in agriculture. Besides grasslands with traditional mowing regime (once or twice a year) we propose to establish unutilised riverine stripes along all water bodies and the establishement of large areas with very extensive all-season cattle grazing (Nickel et al 2016).

In Bayern gilt das Braunkehlchen als „vom Aussterben bedroht“ (Rudolph et al 2016). Die landesweite Erfassung 2005 - 2009 im Rahmen der ADEBAR-Kartierung (Rödl et al 2012) ergab noch einen Bestand von 1200 – 1900 Brutpaaren, während bei der landesweiten Wiesenbrüterkartierung 2014/2015 (Liebel 2015) nur noch 455 BP festgestellt werden konnten.

Eines der (ehemaligen) Kernvorkommen des Braunkehlchens in Bayern ist die Bad Stebener Rodungsinsel im Landkreis Hof (Oberfranken). Der Bestand des Braunkehlchens ist dort von 50 – 60 Brutpaaren Anfang der 1990er-Jahre auf unter 10 Brutpaare in den letzten Jahren eingebrochen.

Um die Ursachen für den Bestandsrückgang quantifizieren zu können, wurde ein gemeinsames Projekt vom Bayerischen Landesamt für Umwelt, der Höheren Naturschutzbehörde der Regierung von Oberfranken, der Unteren Natur-

Tab. 1: Lage der sechs Untersuchungsflächen im Landkreis Hof. - Tab. 1: Location of the six study sites in the vicinity of Hof, northern Bavaria.

Nr.	Lage	Koordinaten	Höhe	Seit 1989 besetztes oder unbesetztes Braunkehlchenrevier
1	S Bad Steben, W Bobengrün	50,341907°N 11,644459°E	540 m	Ja - seit 1989 jedes Jahr besetzt
2	S Bad Steben, E Lochau	50,353257°N 11,633929°E	610 m	Ja - seit 1989 nahezu jedes Jahr besetzt
3	SW Bad Steben, NE Fichten	50,346031°N 11,626111°E	610 m	Ja- seit 1989 nahezu jedes Jahr besetzt
4	N Bad Steben, W Lichtenberg	50,380065°N 11,654365°E	595 m	Nein - ehemaliges Revier (von 1989-2008 regelmässig besetzt)
5	W Bad Steben, W Langenbach	50,377253°N 11,585192°E	650-660 m	Nein - ehemaliges Revier (von 1989-2008 regelmässig besetzt)
6	SW Bad Steben E Geroldsgrün	50,336193°N 11.612739°E	640 m	Nein – 1989 bis Anfang der 2000er Jahre jährlich besetzt. Nach mehreren Jahren verlassenem Revier wurde entbuscht, danach war es erneut besetzt. Seit 2013 endgültig verlassenes Revier

schutzbehörde des Landratsamts Hof und lokalen Ornithologen initiiert. Ziel dieses Projekts ist es festzustellen, ob die (mangelnde) Verfügbarkeit von Insekten, Spinnen und Mollusken, als Nahrungsgrundlage für das Braunkehlchen, ein (Mit-) Grund für die Bestandsrückgänge sein kann. Zu diesem Zweck wurde in der Umgebung von Bad Steben die Häufigkeit von Invertebraten in drei gegenwärtig vom Braunkehlchen noch besetzten Revieren (Flächen Nr. 1 bis 3) und in drei seit einigen Jahren verwaisten, ehemaligen Braunkehlchenrevieren (Flächen Nr. 4 bis 6) vergleichend untersucht (siehe Tabelle 1).

Die Erfassung der Tiere erfolgte über neun jeweils vierzehntägige Fangperioden (FP) in den Jahren 2016 und 2017 (3 FP im Frühsommer 2016, 1 FP im August 2016, 4 FP im Frühsommer 2017, 1 FP Ende August 2017, siehe Tabelle 2). Zum Einsatz kamen pro Fläche eine Malaisefalle und ein Biozönometer. Die Malaisefalle (Abb. 1) dient zum semiquantitativen Fang vorwiegend flugaktiver Insekten, während das Biozönometer (Abb. 2) eine Fläche von 1 x 1m² bedeckt und hier mit einer Bodenfalle und einer Kopfdose die auf dieser Fläche lebenden bzw. sich entwickelnden Arthropoden quantitativ erfasst werden.

Zur Auswertung wurden die Inhalte der Fänge aller Fallen für insgesamt 17 Tiergruppen einzeln ausgezählt, wobei nur Individuen mit einer Körperlänge zwischen 1mm und 11mm dokumentiert wurden.

In Summe wurden auf den sechs Flächen in den neun Fangperioden mehr als 147.000 wirbellose Tiere nachgewiesen. 94,3% der Tiere wurden mittels Malaisefallen gefangen, 3,4% stammen aus den Bodenfallen der Biozönometer und 2,3% aus den Biozönometer-Kopfdosen.

56,4% der insgesamt gefangenen Tiere zählten zu den brachyceren Fliegen, 23,8% waren Mücken, 4,3% Taillenwespen (Bienen, Wespen), 3,0% Käfer, 2,8% Schmetterlinge, 2,4% Pflanzenläuse und 2,0% Zikaden. Alle übrigen Gruppen stellten jeweils weniger als 2% der Gesamtausbeute dar

Tab. 2: Übersicht der Fangperioden (FP) auf den sechs Untersuchungsflächen. - Tab. 2: Sampling periods (FP) on the study sites.

2016				2017				
FP 1	FP 2	FP 3	FP 4	FP 5	FP 6	FP 7	FP 8	FP 9
14./15.-28.6.16	28.6.-11.7.16	11.7.-25.7.16	29.8.-12.9.16	3.-16.5.17	16.-29./30.5.17	30.5.-12./13.6.17	12./13.-26.6.17	21.8.-4.9.17


Abb. 1 und 2: Malaisefalle (links) und Biozönometer (rechts) auf Fläche Nr. 5. - Fig. 1 and 2: Malaise trap (left) and biocoenometer (right) on site no. 5 (Photos: ©: L. Schlosser).

(siehe Tab. 3).

Die Abundanzunterschiede zwischen den einzelnen Flächen sind deutlich geringer als die Schwankungen auf einer Fläche im Jahreslauf. Die höchsten Abundanzen sind in der zweiten Maihälfte anzutreffen. In der ersten Junihälfte sinkt die Zahl um durchschnittlich 38,5% und in den nächsten Wochen sinkt sie nochmals. Die Ursache ist wahrscheinlich die großflächige Wiesenmahd in diesem Zeitfenster. Im Juli erholen sich die Insektenbestände leicht, die geringsten Fangzahlen gibt es Ende August.

Bemerkenswert ist, dass die Individuenzahlen der Wirbellosen ihren Höhepunkt eindeutig Ende Mai erreichen (Abb. 1). In den 1990er Jahren wurde für das Braunkehlchen im Frankenwald als mittlerer Legebeginn der 18. Mai (n=61) festgestellt (Feulner 1995), d.h. die Aufzucht der Jungvögel

Tab. 3: Gesamt-Fangergebnisse auf den sechs Untersuchungsflächen. - Tab. 3: Total numbers of invertebrates sampled on the six sites within 9 sampling periods by Malaise traps and biocoenometers.

Tiergruppe (Wiss.)	Tiergruppe (Dt.)	Malaise-Falle	Biozön-Kopf	Biozön-Boden	Summe	Anteil [%]
Brachycera	Fliegen	81.442	1.459	172	83.073	56,4
Nematocera	Mücken	34.120	675	179	34.992	23,8
Apocrita *(excl. Formicidae)*	Taillenwespen (ohne Ameisen)	6.022	141	211	6.374	4,3
Coleoptera	Käfer	2.848	188	1.400	4.436	3,0
Lepidoptera	Schmetterlinge	4.099	66	33	4.198	2,8
Sternorrhyncha	Pflanzenläuse	3.042	345	100	3.487	2,4
Auchenorrhyncha	Zikaden	2.388	140	459	2.937	2,0
Pterygota sonstige	Andere Insekten	2.653	54	5	2.712	1,8
Araneae	Spinnen	636	123	1.412	2.171	1,5
Formicidae	Ameisen	96	119	859	1.074	0,7
Symphyta	Pflanzenwespen	1.024	25	0	1.049	0,7
Heteroptera	Wanzen	445	56	31	532	0,4
Opiliones	Weberknechte	78	18	53	149	0,1
Saltatoria	Heuschrecken	74	4	16	94	0,063
Dermaptera	Ohrwürmer	36	2	0	38	0,026
Oligochaeta	Wenigborster	0	0	31	31	0,021
Gastropoda	Weichtiere	0	0	18	18	0,012
Summe		138.953	3.415	4.997	147.365	100,0

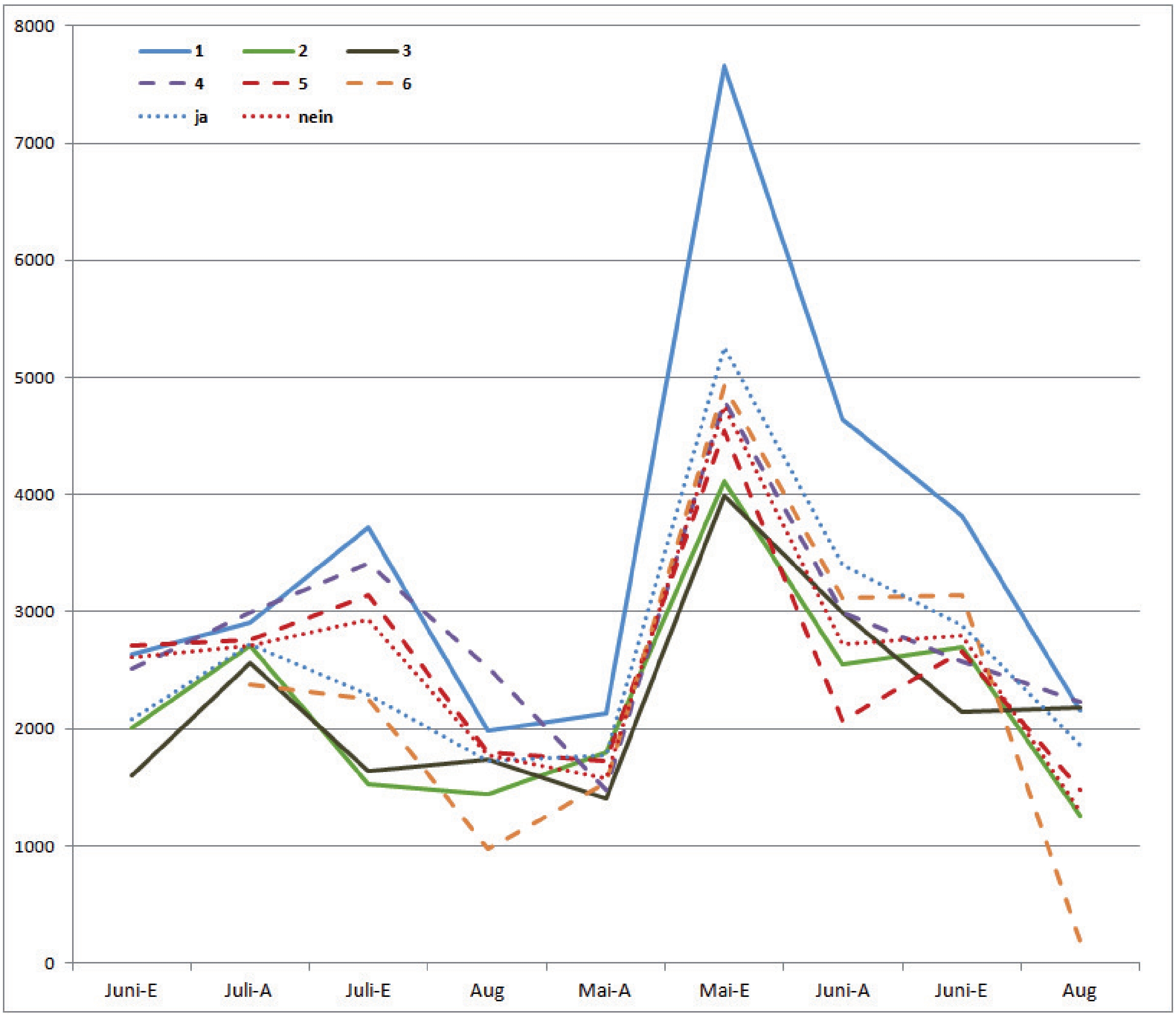

Abb. 3: Jahresverlauf der pro 14-tägigem Fangintervall festgestellten Wirbellosen-Individuenzahlen in den Malaisefallen in aktuell besetzten und ehemals, verlassenen Braunkehlchenrevieren. Die Werte für die aktuell besiedelten Flächen (1, 2, 3) sind als durchgezogene Linie dargestellt, unterbrochene Linien stellen die Werte für aktuell verwaiste Reviere (4, 5, 6) dar. Die Mittelwerte der jeweils drei Flächentypen werden punktiert dargestellt (blau = ja, durch Braunkehlchen besetzt; rot = nein, verwaistes Braunkehlchenrevier).-
Fig. 3: Numbers of Invertebrates sampled in course of the year by Malaise traps in recent and former Whinchat habitats. Recent habitats (sites 1, 2, 3) are shown in continuous lines, discontinuous lines show former habitats (sites 4, 5, 6). Mean values are dotted lines (blue = with Whinchat, red = without).

und der damit verbundene erhöhte Nahrungsbedarf fiel hier vornehmlich auf den Juni. In diesem Monat ist aber die Individuenzahl der Wirbellosen im Moment gegenüber Ende Mai teilweise um über 50% geringer. Hierbei ist anzumerken, dass die extensive Mähnutzung naturschutzfachlich wertvoller Lebensräume, gem. Bayerischen Vertragsnaturschutzprogramm, zu ausgewählten Terminen ab dem 01.06. erfolgt. Dass es bei den verschiedenen Mahdterminen negative Korrelationen mit der Invertebraten-Vielfalt und der Biomasse der Insekten gibt, belegt eine Untersuchung des LfU aus dem Königsauer Moos (MACZEY et. al 2017). Die Autoren legen dar, dass die Bestandseinbrüche von Invertebraten nach der Mahd durch die vorzeitige Anlage von Brachen und Frühmahdstreifen teilweise aufgefangen werden können. Durch die Brachen werden Refugialräume geschaffen, die eine bessere Überwinterung von Invertebraten und stärkere darauf folgende Ausbreitung im Frühjahr ermöglichen.

Zur Nahrungsverfügbarkeit stellt sich zudem die Frage, ob sich eventuell durch eine veränderte landwirtschaftliche Nutzung oder durch klimatische Veränderungen die Phänologie der Nahrungsverfügbarkeit für das Braunkehlchen verschlechtert hat? Ist das Braunkehlchen in der Lage seinen Brutzeitraum an die möglicherweise veränderte Situation anzupassen? Inwieweit die Brutphänologie des kleinen Wiesenbrüters mit der Nahrungsverfügbarkeit korreliert, sollte daher als eine mögliche Ursache für den Rückgang der Art in Zukunft näher untersucht werden.

Auswertungen der Biozönometer-Daten zeigen, dass es zwar deutliche Schwankungen der Individuenzahlen zwischen den Flächen und Untersuchungszeiträumen gibt, diese jedoch nicht mit der Präsenz/Absenz des Braunkehlchens in diesen zwei Untersuchungsjahren in Zusammenhang stehen.

Aufgrund des generellen Verlusts an Insekten-Biomasse in den letzten Jahrzehnten (z.B. Hallmann et al 2017) ist dennoch davon auszugehen, dass die verringerte Nahrungsverfügbarkeit auf Landschaftsebene ein wesentlicher Faktor für die Populationsgrößenabnahme des Braunkehlchens ist.

Maßnahmen zur Attraktivitätssteigerung von Flächen als Brutreviere der kleinen Wiesenbrüterart (z.B. Sitzwarten) sind zweifelsfrei dazu geeignet, den Rückgang kurzfristig anzuhalten. Längerfristig wird es allerdings von entscheidender Bedeutung sein, die Insektendichten durch Diversifizierung der Landnutzung großflächig (nicht nur auf Einzelflächen) wieder erheblich zu erhöhen. Neben traditioneller extensiver Grünlandnutzung (ein- bis zweischürige Mahd) sind weitere extensiv genutzte Flächen erforderlich. Eine aus fachlicher Sicht sinnvolle Maßnahme wären extensiv genutzte Gewässerrandstreifen mit einer Mindestbreite von 5 m breiten Streifen beidseits aller stehenden und fließenden Gewässern (gem. §38 Abs. 3 WHG.), der nicht in allen Bundesländern gesetzlich verbindlich ist (vgl. Art. 21 BayWG).

Zur Steigerung der Insektenbiomasse und Vielfalt der Invertebraten wird zudem die Einrichtung eines oder mehrerer großflächiger Gebiete mit extensiver Ganzjahresbeweidung (z. B. Nickel et al 2016) im Bericht des LfU (Holzinger et al 2017) vorgeschlagen.

Weitere Ergebnisse der Untersuchung finden Sie unter/For further information on this project, see:

Holzinger WE, Siering M, Feulner J, Fröhlich D, Gunczy LW, Huemer S, Schlosser L 2017: Quantifizierung von wirbellosen Tierarten als Nahrungsgrundlage für das Braunkehlchen auf der Bad Stebener Rodungsinsel im Landkreis Hof, Oberfranken. Untersuchung in den Jahren 2016 – 2017. Bayerisches Landesamt für Umwelt (Hrsg.), 49p.

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Improving Whinchat habitats in the Murnauer Moos, Germany

District Office Garmisch-Partenkirchen & Max Planck Institute for Ornithology

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Liebel HT, Goymann W 2017: Improving Whinchat habitats in the Murnauer Moos, Germany. WhinCHAT 2, 49-55.

The Murnauer Moos is the largest, more or less intact wetland and bog in Central Europe with a formerly large population of whinchats (*Saxicola rubetra*). Even though a large part of the area is protected as nature reserve and Natura 2000 site, whinchats have disappeared from many of their former territories. To support the local population, meadow stripes of varying forms and dimensions were left uncut in 2016. In the following breeding season, the number of whinchats holding territories in one of the monitored areas increased by one third compared to 2016. Whinchats preferred fallow stripes for nesting and had a high breeding success in the study area in 2017, presumably due to the presence of fallow stripes in combination with favorable weather conditions.

The Murnauer Moos – a whinchat's paradise?

The Murnauer Moos (district Garmisch-Partenkirchen, Bavaria, Germany) is part of the northern foothills of the Alps at an altitude of 640 to 717m a.s.l. (see Fig. 1). It consists of a diverse natural landscape in a triangular basin (about 45km²) between two alpine mountain chains in the south-east and south-west and a hilly border in the north.

Within the Murnauer Moos, areas with the highest values for nature conservation have been protected as nature reserve (23,78km²); in addition there are special protected areas for birds (42,94km²; SPA, Natura 2000). Large parts of the basin are covered with swamps, bogs and wet grasslands which traditionally have been one of the core areas for whinchats (*Saxicola rubetra*) in Bavaria. Bezzel (1989) mentions that in the 1980's the highest whinchat densities were found outside the nature reserve in extensively used grasslands. Since then, land use has drastically changed: areas in the surroundings of the nature reserve have turned into intensively used, fertilized meadows that are cut several times during the year, and large areas within the core area of the wetland are no longer cut at all. As a consequence, bushlands and dense reed beds have developed during the last decades. Both of these developments have reduced the habitat quality

Fig. 1: Basin of the Murnauer Moos seen from mount Heimgarten towards northwest (Photo: © Heiko T. Liebel).

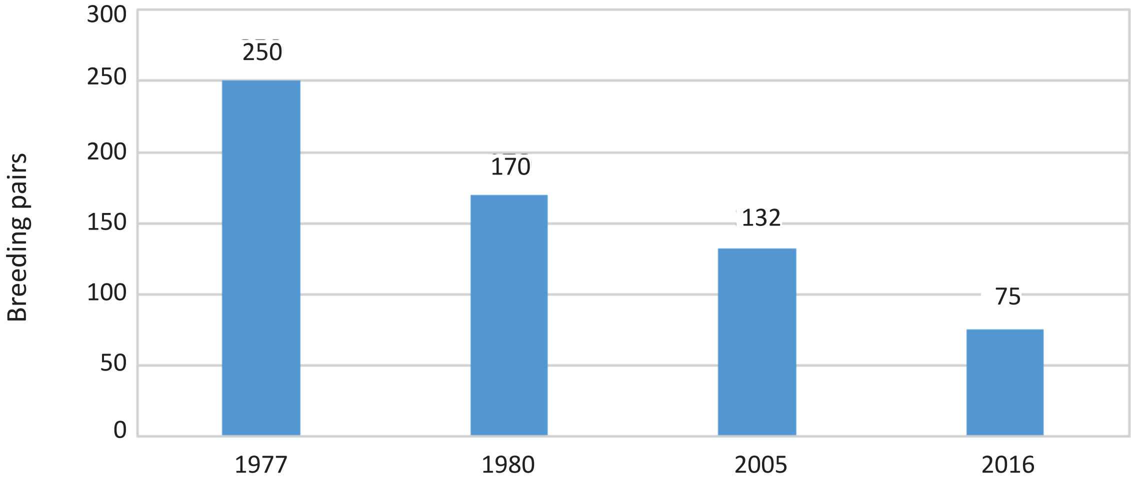

Fig. 2: Population decline of whinchats in the Murnauer Moos (Bezzel & Lechner 1978, database at LfU; Weiss 2016; in case of ranges the lower number was used).

for whinchats and are in part responsible for the local decline of whinchats (see Fig. 2).

A mapping project of grassland birds of the whole area in 2016 (Weiss 2016) showed that the once large whinchat population had dropped by more than 50% since 1977 and consisted of only 75-95 breeding pairs in 2016. The remaining population is mainly founded on wet grassland areas within the nature reserve that are cut only once a year and not before September 1st.

The overall decline of whinchats in Bavaria (Liebel 2015, Rudolph et al 2016) in combination with the drastic population crash in the Murnauer Moos motivated us to engage in a closer monitoring and designing specific measures to support whinchats in the area. The mapping project of Weiss (2016) provided us with an ideal basis to survey the success of these measures.

Measures to improve habitats

At the southern end of lake Ammersee (districts Weilheim-Schongau and Landsberg am Lech) fallow stripes have been used to attract whinchats when arriving from their wintering grounds by offering natural perches for hunting and singing. While these measures had been successful in recruiting whinchats during the first couple of years (C. Niederbichler, pers. comm.), recent

Fig. 3: Digitizing of fallow stripes in winter (Photo: © Heiko T. Liebel).

years have seen a new decline in whinchats, even though the habitat seems to be suitable (R. Griessmeyer, pers. comm.).

Impressed by the (at least) initial success of the measures at lake Ammersee, farmers of the Murnauer Moos area were encouraged to leave parts of their grasslands uncut, thereby creating fallow stripes of old uncut grassland. In the Bavarian system of contractual nature conservation (i.e. "Vertragsnaturschutzprogramm") farmers can leave up to 20% of their grasslands uncut without financial reward. Another possibility offers them financial compensation if they leave 5 - 20% of their meadows uncut and thus create obligatory fallow stripes. In both cases fallow stripes must not be established in the same area between years; instead different areas need to be selected and left uncut in subsequent years. In 2016, the district started to promote the establishment of fallow stripes among farmers that had contracts within the core areas for whinchats. Members of the District Office helped farmers using a GPS device to avoid fines in case uncut areas should have exceeded the 20% limit of uncut area.

Mapping of territories and breeding success

In spring 2017, territories of whinchats were mapped in two important subareas for whinchats the Weidmoos and the Niedermoos.

Weidmoos

In the Weidmoos territories were mapped twice, on May 5th and June 9th, 2017 in a project area covering 73ha, both times without leaving the car to avoid disturbing the last pair of breeding Eurasian Curlews (*Numenius arquata*) in the Murnauer Moos. Mapping until May 21st might be influenced by migrating individuals as demonstrated by Geiersberger (2012). The results indicate an increase in whinchat territories by about one third compared with the previous year (Weiss 2016). In 2016 there were only two or three small fallow stripes. In 2017, an area of 3.6ha

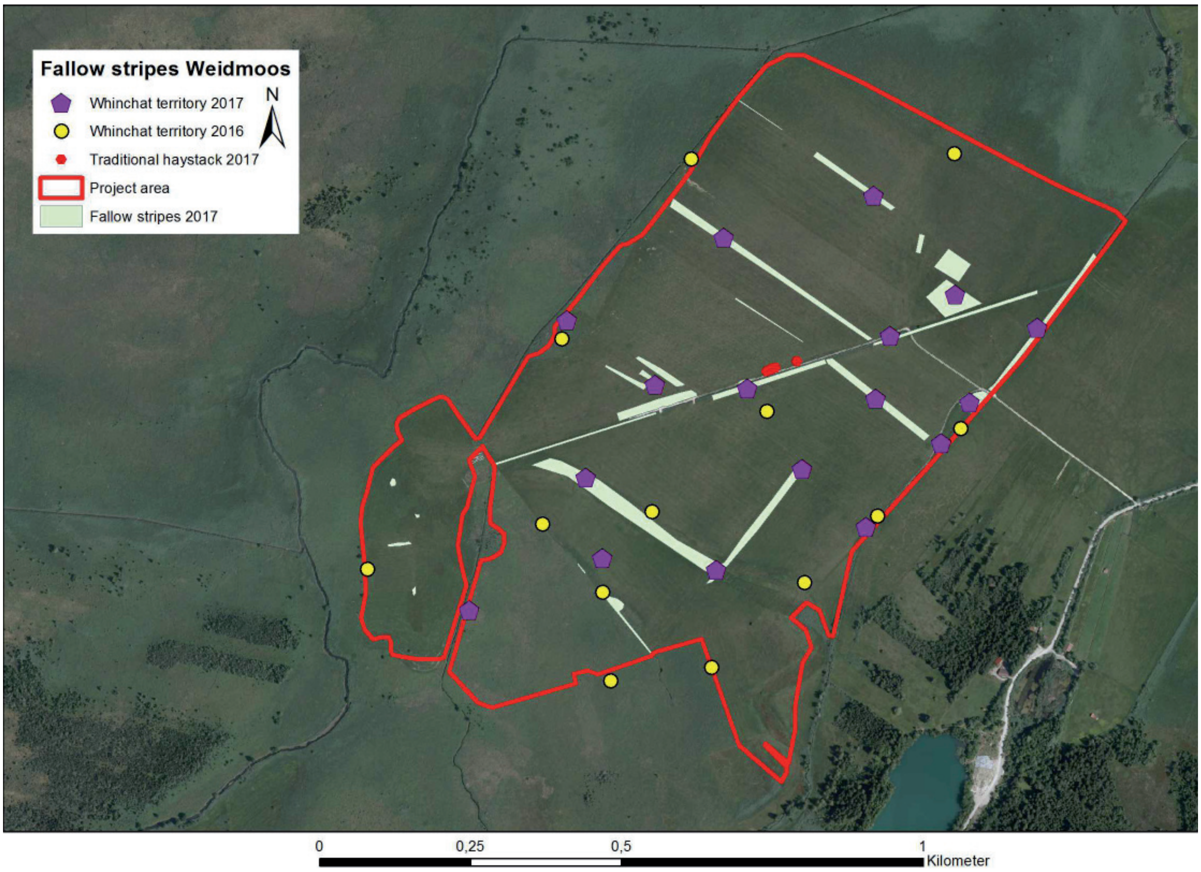

Fig. 4: Comparison of whinchat territories at Weidmoos 2016 with few and 2017 with several fallow stripes (note: northern- and southernmost areas of the project area were not covered well due to long observation distance from the car).

Fig. 5: Female whinchat at Murnauer Moos in spring 2017 (Photo: © Heiko T. Liebel).

were left uncut (about 5% of the grasslands). The stripes were of varying forms and contained a varying amount of reed (*Phragmites australis*), which whinchats used as perches. Most stripes were at least five meters wide. Obviously, whinchats used the fallow stripes in this subarea as song posts and in 2017 were more likely to settle within the large meadow. In 2016, they mainly settled at the border of the adjacent large reed beds that surround the project area in the north, west and south.

The population density within the project area was 2.3 territories/10ha in 2017 compared to 1.6 territories/10ha in 2016. Hence, the population density was still much lower than densities in ideal habitats managed with fallow stripes at

Fig. 6: Narrow fallow stripes at Niedermoos (Photo: © Heiko T. Liebel).

Federsee (Baden-Württemberg), for example, where 6 territories/10ha are reached in nutrient-poor and sedge-rich meadows (Einstein 2006, 2015). At the Tyrolean hot spot for whinchats in the Ehrwald basin (35km southwest of Murnauer Moos; A. Schwarzenberger 2017, pers. comm.) population densities of 4.5 territories/10 ha are also higher than within the best subareas within the Murnauer Moos. During later visits in June, several juvenile whinchats could be observed within the Weidmoos, indicating that whinchats successfully bred within the area.

Niedermoos

Niedermoos is one of three study areas where the Max-Planck-Institute for Ornithology investigates breeding success, interactions and competition between whinchats and stonechats (*Saxicola rubicola*). The site was chosen, because it is an important breeding area for both species. Further, measures to improve habitat quality can be realized in this location, as a large fraction of the area is owned by nature protection organizations (e.g. LBV) or the District. In 2016, a farmer left narrow stripes of the meadow unmown after every turn that he did with his tractor (Fig. 6). The result were more than 60 narrow fallow stripes of about one meter width. During spring migration in April we observed that many whinchats used these narrow fallow stripes as hunting perches.

The mapping of whinchats in this area of narrow fallow stripes did not demonstrate an increase in number of whinchat territories between 2016 and 2017, possibly because of the nutrient-poor humid meadows that lack plant species that grow high enough to serve as perches for the chats. However, intense search for nests and follow-up observations showed that the structures were used for reproduction. A total of 17 nests was found (Fig. 7), with ten of them located in fallow stripes (Fig. 8), three at the border to permanent fallow areas that are dominated by reed, three further nests were within the mown meadow, and one nest below a bunch of old mown grass

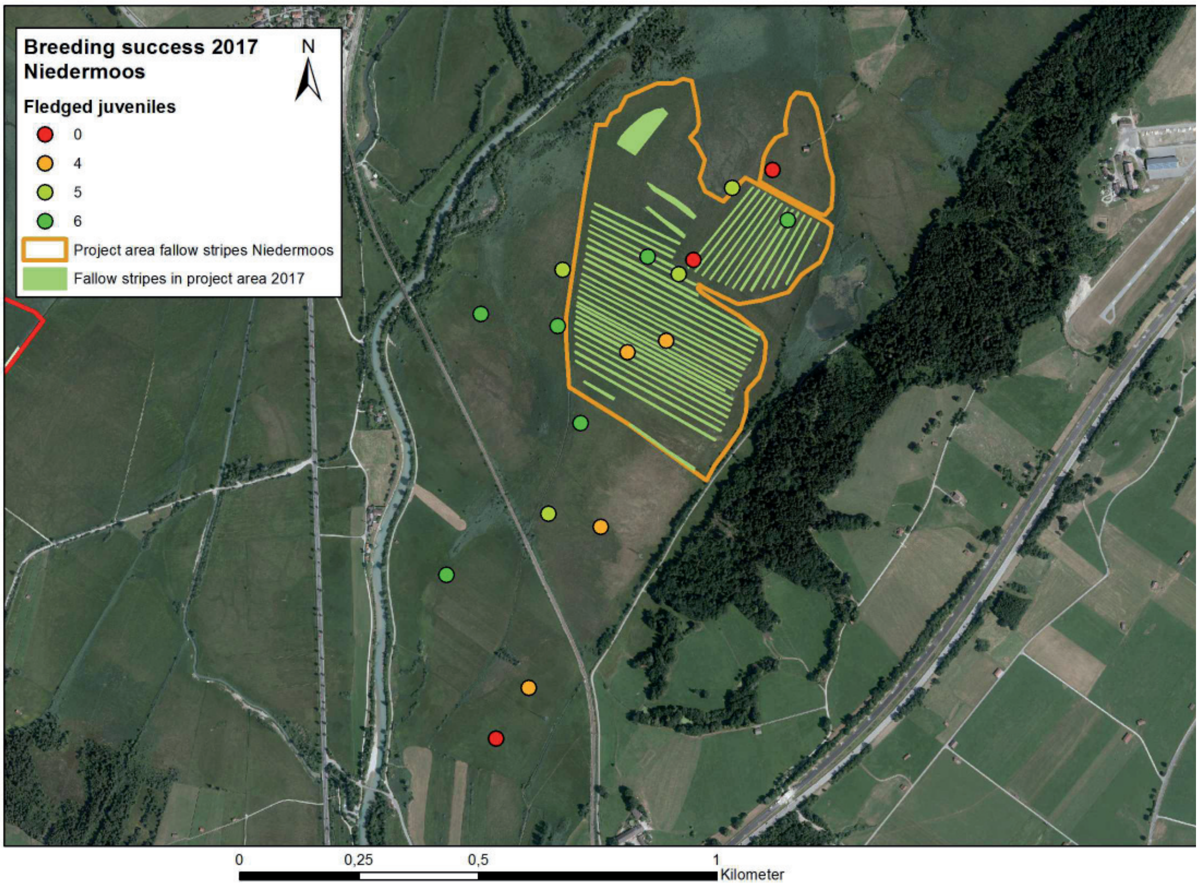

Fig. 7: Breeding success of whinchats at Niedermoos 2017. Note that the location of fallow stripes is only indicated for the project area, there were further unmapped fallow stripes within the rest of the area.

Fig. 8: Nest of whinchats in a fallow stripe (Photo: © Wolfgang Goymann).

that had remained in the meadow. Three nests were depredated by unknown predators, but two of the affected pairs immediately produced a replacement clutch and successfully bred in their second attempt. A surprisingly large number of 72 juvenile whinchats fledged. Also one of the other main grassland birds in the area, the meadow pipit (*Anthus pratensis*) used the fallow stripes for nesting.

Fig. 9: Late flowering plants (like *Gentiana pneumonanthe* in the foreground) and insects benefit from fallow stripes as well (Photo: © Heiko T. Liebel).

Conclusions

Fallow stripes had a positive effect to attract whinchats within the study areas in the Murnauer Moos. Compared to other breeding sites of whinchats elsewhere, it is obvious that the densities reached within the Murnauer Moos are still below the potential for whinchats. The comparison of whinchat territories in the Weidmoos between 2016 and 2017 clearly shows that temporary fallow structures and the presence of perches may be the dominating limiting factors for suitable whinchat habitat within this part of the Murnauer Moos. Fallow stripes may not only help to increase breeding densities of whinchats, they may also represent important hunting perches for migrants passing through, i.e. a measure to improve migratory connectivity. Further, because whinchats preferentially chose fallow stripes as nesting sites, they could potentially be attracted to more intensely farmed areas (i.e. meadows that are cut more often), if they would offer such stripes with safe nesting possibilities. Of course, such measures also depend on other factors, i.e. a sufficient insect density in more intensely farmed areas will be required to successfully raise a brood.

The aim of this contribution is to publicly promote the positive effect of fallow structures for whinchats and to promote contracts including obligatory fallow stripes in nutrient-poor extensive grasslands during the contract negotiations with local farmers that participate in the contractual nature conservation program.

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Tackling conservation challenges from the ground up: delayed mowing for the Whinchat

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Gray A, Copland AS, Kenny K, McMahon BJ 2017: Tackling conservation challenges from the ground up: delayed mowing for the Whinchat. WhinCHAT 2, 56-57.

Agricultural intensification is comparable to deforestation and anthropogenic climate change as one of the greatest threats to biodiversity across the globe. The twin challenges of food provision for a growing human population and the sustainable use of biological resources continue to plague decision makers. Agriculture and the environment have a complex relationship that is bound by agriculture's simultaneous exploitation and creation of ecosystem services. Similarly, agriculture systems are essential for the survival of many species for food, shelter, water and breeding yet they are also hugely culpable in their demise.

For the ground nesting Whinchat, early and more frequent grassland mowing throughout their breeding range has likely contributed to range contraction and population declines. The first European Whinchat Symposium 2015 concluded that the species has experienced a 50-90% decline over the last 20 years. Implementing locally led agri-environmental schemes in Whinchat stronghold areas across Europe could aid the recovery of

Fig. 1: A Whinchat located on Tower Callow, a wet grassland meadow site next to the River Shannon in Banagher, Co. Offaly, Ireland (Photo: © Alex Copland).

this bird of conservation concern.

The Whinchat is poorly understood in Ireland with this research only being the second of it's kind. The Shannon Callows is the Whinchats breeding population stronghold in Ireland and therefore an appropriate location for conservation action (Fig. 1). As in Europe, delayed mowing is urgently required to halt the decline of this vulnerable species.

According to current literature, 75.1% of Whinchat fledglings must survive the breeding season if populations are to remain unchanged. Delaying mowing is an expensive incovenience for the farming community; therefore research into a Whinchat territory size is crucial to target conservation. If mowing can be delayed across a territory this will presumably result in population recruitment and can avoid a call for delayed mowing over entire farms creating an environmentally and economically viable conservation option. This work seeks to aid Whinchat population recovery in Ireland, improve food availability for insectivores and serve as an example of a species targeted conservation plan.

With the International Whinchat Working Group, cross-border collaboration is probable. Whinchats are representative of the larger agricultural biocenosis and this project will provide solutions for policy makers to balance agricultural usage and biodiversity requirements, thus encouraging a more stable agri-ecosystem.

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Population estimation and breeding success of Whinchat (*Saxicola rubetra*) at RSPB Geltsdale, Cumbria, UK

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Ames E 2017: Population estimation and breeding success of Whinchat (*Saxicola rubetra*) at RSPB Geltsdale, Cumbria, UK. WhinCHAT 2, 58-64.

Long-term monitoring of Whinchats (*Saxicola rubetra*) requires standardised survey effort and reliable population estimates. Distance sampling was found to underestimate the known population of whinchats at Geltsdale but provided a better index than transect counts. The negative bias may be due to violation of key assumptions of the distance sampling method, and differences in detectability between the sexes and between paired and unpaired males. Improvements to the methods could increase the accuracy of population estimates, but may also increase the complexity of both data collection and statistical analyses. Double sampling may provide a simpler method of correcting for bias, and could also allow measures of productivity and therefore assessment of the impact of management strategies on breeding success.

Details of an MSc research project conducted at RSPB Geltsdale in 2016.

Introduction

The population of Whinchats at RSPB Geltsdale reserve has been closely monitored since 2011. For continued monitoring to be viable and effective, rapid assessment methods which standardise survey effort and provide reliable population estimates are needed. Population indices and abundance estimates of Whinchats produced by line transect surveys and distance sampling were compared with numbers from intensive surveys using a double sampling approach. Factors influencing detectability during transect surveys were investigated, including sex, detection method, breeding status, breeding stage, and incubation activity. Incubation regimes and nest survival were monitored using temperature sensors in nests.

Methods

9 1-km line transect surveys were conducted at Geltsdale between 2014 and 2016 (Fig. 1). Three visits were made to each transect: (1) 15-22 May, (2) 23-30 May, (3) 31 May – 7 June, between 05:00 and 09:00 AM. Sex and detection method were recorded on transect surveys in 2016. Distance sampling (Buckland et al 2001) was performed in 2015 and 2016, and Distance software (Distance 7 Release 1, Thomas et al 2010) used to produce population estimates. Limited numbers of detections necessitated use of data from all

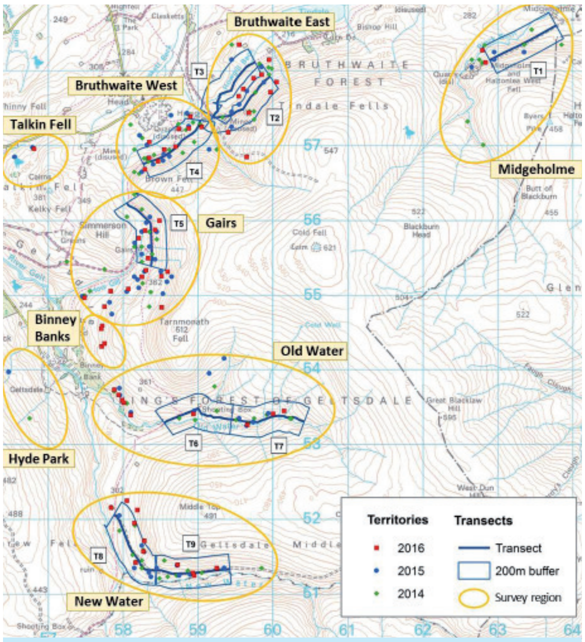

Fig. 1: A map of the study area at RSPB Geltsdale Reserve in the North Pennines, showing the survey regions, transect routes (T1 to T9) and whinchat territories between 2014 and 2016. Known replacement and second broods in 2016 are not shown. A 200-metre buffer on either side of each transect route shows the area covered by each transect survey. In 2016, the survey regions Bruthwaite East (BE), Bruthwaite West (BW) and the Gairs (G) were the focus of intensive searches in May. In June 2016, additional observers enabled searching of Binney Banks (BB), Old Water (OW), New Water (NW), Midgeholme (M), Talkin Fell (TF) and Hyde Park (HP). © Crown Copyright OS 1:50,000 Scale Colour Raster 2016. An Ordnance Survey/ Edina supplied service.

Fig. 2: Whinchat pair in the study area at Bruthwaite East, Transect 2 (Photo: © Stephen Westerberg).

three visits, with abundance estimated from the mean. Transect survey areas were also intensively searched, and the locations of all whinchats recorded, including colour combinations of all colour-ringed individuals. Territory mapping and nest-finding methods were used to estimate the true population. Thermochron® iButton® temperature sensors were placed in nests to record incubation activity (at 2-minute intervals for a 68-hour period; Fig. 8) and monitor nest survival and predation events (at 20-minute intervals for the duration of the nesting period) in 2016.

Results

Intensive sampling, transect counts and distance sampling all detected a decrease in the whinchat population between 2014 and 2016 (Tab. 1).

On a single transect visit, in 2016, a mean of 55% of active territories were detected. Summed maximum counts of males by 200 m section across the three visits for each transect ('Section-maximum') were more highly correlated with the number of territories estimated from intensive sampling ('known' territories) than means or

Tab. 1: Numbers of whinchats recorded by different survey methods between 2014 and 2016. Distance sampling estimates are given with 95% confidence intervals (CI).

Survey	Measure	2014	2015	2016
Intensive Search	Territory	52	42	35
	Pair	36	24	25
Transect Maximum	Male	38	28	24
	Female	9	5	7
Section Maximum	Male		32	30
	Female		6	8
Distance Sampling	Male		33 (CI 21.5-50.1)	27 (CI 17.3 – 41.6)
	0.5*(Individual)		18.5 (CI 13.1 – 26.6)	17 (CI 11.0 – 26.2)

Fig. 3: Study area surrounding Transect 4, Bruthwaite West, RSPB Geltsdale reserve, Cumbria, UK (Photo: © Elinor AMES).

whole transect maxima. A calibration factor of 1.237, obtained from regression, was required to estimate the number of territories from the Section-maximum number of males. Distance sampling underestimated the known population, and a calibration factor (1.298) was required (Fig. 5). Better estimates of the number of territories were produced using the number of males than half the number of individuals (Tab. 1). Proportional changes in distance sampling estimates and known population numbers were significantly correlated; distance sampling therefore provided a better population index than Section-maximum counts.

Tab. 2: Nest survival by year, 2014 – 2016, calculated using the Mayfield method (MAYFIELD 1975, JOHNSON 1979).

YEAR	NEST SURVIVAL
2014	33.3% (CI 17.5 – 62.4%)
2015	34.1% (CI 18.6 – 61.5%)
2016	78.0% (CI 62.4 – 97.3%)
MEAN 2014-2016	49.9% (CI 38.7 – 64.2%)

Males were more detectable than females. Between 2014-2016, males made up 59.9% of the population, but accounted for 85.6% of transect detections. In 2016, 63.3% of male detections were by sound, with male song allowing detections over greater distances than females (Fig. 6). Breeding status also affected detectability; unpaired males were more detectable than paired males. In 2016 paired males were detected singing on only 24% of the occasions they were known to be present compared with 80% of occasions for unpaired males, and were recorded singing on fewer visits than unpaired males. No clear effect of breeding stage was found on detectability, likely due to the small sample size and study methods.

The incubation study suggested that incubating females may be available for only 16% of the time during the transect survey period (05:00 AM to 09:00 AM), and less detectable during this period than later in the day, but this result was not significant due to the small sample size (n=5; Fig. 7), and further studies are needed. Breeding success and nest survival were highest in 2016, and varied between years (Tab. 2). Predation rates were low, and occurred mostly during daylight, in contrast to the findings of Taylor (2015) on Salisbury Plain.

Discussion

Distance sampling provided a better population index than maximum counts from line transects, but underestimated the known population. This may have been due to use of mean rather than maximum counts, and possible violations of key distance sampling assumptions: that distance measurements are exact; individuals are distributed independently of transect lines; individuals on the line are detected with certainty; and individuals are detected at their initial location (Buckland et al 2001, Thomas et al 2010). Overestimation of distances would negatively bias estimates (Buckland et al 2001), and use of laser range finders or recording distances in bands could increase accuracy in future surveys (Buckland et al 2015). The transect routes were fixed along tracks in areas of known high territory density for ease of access and repeatability. However, tracks may influence territory distribution patterns, and avoidance of the transect line by whinchats would negatively bias population estimates; estimates in this study were therefore limited to the area covered by the transect surveys. Where detection on the line is uncertain, for example when individuals are foraging in dense vegetation, more complex methods such as mark-recapture distance sampling, or restricting detection to audible cues such as male song could be used to address this (Buckland et al 2015). Undetected evasive movement of individuals would also cause negative bias in the population estimates; this should be minimised by scanning well ahead and adjusting the speed of travel to detect individuals before they are disturbed (Buckland et al 2001, 2015). Multiple covariate distance sampling could be used to account for variation in detection probabilities between categories such as males and females, or different detection methods (Stanbury & Gregory 2009, Buckland et al 2015). Availability models

Fig. 4: Study area surrounding Transect 5, The Gairs, RSPB Geltsdale reserve, Cumbria, UK (Photo: © Elinor Ames).

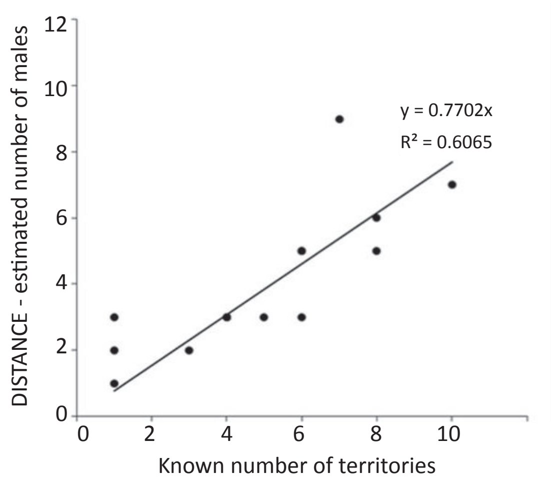

Fig. 5: The relationship between the estimated number of territories generated from Distance analysis and the number of known territories found during intensive searches in each of the one kilometre transect areas in 2015 and 2016. Estimates for the number of territories were generated from the number of males using means of the three transect visits.

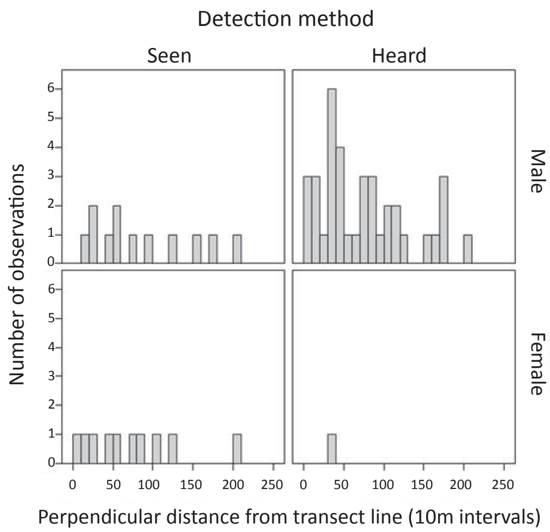

Fig. 6: Distribution of whinchat observations in 2016, in 10m distance intervals from the transect line, for males and females, and for different methods of detection. The detection method refers to the way in which each whinchat was first identified by the observer. Individuals were often seen after first being heard, or heard to sing or call after first being seen. For males, detection by sound includes both song and calls, whereas for females this refers only to calls.

and multipliers may also need to be considered if incubating females are to be included in the analysis (Buckland et al 2015). The higher detectability of unpaired males could also mask the true extent of population declines (Morrison et al 2016), especially if restricting surveys to singing

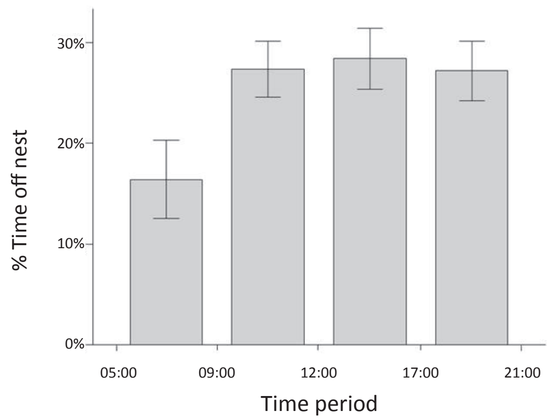

Fig. 7: The percentage of time spent off the nest by female whinchats in 4-hour time periods through the day. The first period, from 05:00 to 09:00 AM, was the time during which transect surveys were undertaken. Timings were obtained from iButtons which recorded nest temperatures at 2-minute intervals for 48 hours in five nests. Bars are ± 1 standard error. Assuming correct identification of arrival and departure events from temperature data, departure and arrival times were accurate to ± 2 minutes; the overall duration of each on- or off-bout was therefore accurate to ± 4 minutes. The difference between the time periods, though notable, is not significant, likely due to the small sample size: Friedman's 2 way ANOVA H=6.918, df=3, p=0.075, n=5.

males. A measure of the proportion of unpaired males, or an additional measure of breeding activity such as the presence of females, nests or behaviour indicating young would therefore be desirable to avoid overestimating the breeding population.

A greater sampling effort and more comprehensive environmental data is needed to fully investigate the preliminary findings of the incubation study. iButtons were found to be frequently removed from nests, and methods were needed to prevent this. Susceptibility to brood parasitization by common cuckoo *Cuculus canorus* may encourage removal of foreign objects from nests; careful fixture and camouflage of iButtons are therefore recommended in future studies to avoid impacts on incubation behaviour (Smith et al 2015). High nest survival demonstrates the potential for high productivity at Geltsdale and the importance of this site for breeding whinchats, but as considerable variation can occur in predator activity and nest survival between years, longer-term studies are needed. Continued monitoring of productivity would enable an assessment of the impact of management strategies and efforts to reverse current population declines.

Conclusion

By accounting for variation in detectability, distance sampling provides a more reliable index than maximum counts from line transects, and may be sufficient for detecting declines and monitoring the overall population trend. However, as an estimator of absolute abundance, distance sampling as conducted here suffers from a considerable negative bias, indicating probable violation of key assumptions and other significant influences on detectability such as sex and breeding status. The accuracy of distance sampling estimates may be improved with some simple alterations to the methods used in the present study, including increasing the accuracy of distance measurements by recording in distance intervals or using laser range finders; including sex and detection method as covariates in the models; and random placement of transects throughout the study area. More complex methods such as incorporating measures of cue frequency in males and female detectability during incubation in availability models, and mark-recapture distance sampling to estimate detectability on the transect line could further improve estimates but would require more advanced statistical methods and data collection and would be more time consuming and resource intensive. If an accurate abundance estimate is required, unless such improvements significantly reduce the bias of distance sampling estimates, it may prove simpler and more cost effective to derive a calibration factor from an intensively sampled subset of survey plots in a double sampling approach (Bart & Earnst 2002, Collins 2007), simultaneously providing the opportunity to record breeding status and productivity and enabling an assessment of the impact of management strategies and efforts to reverse current population declines.

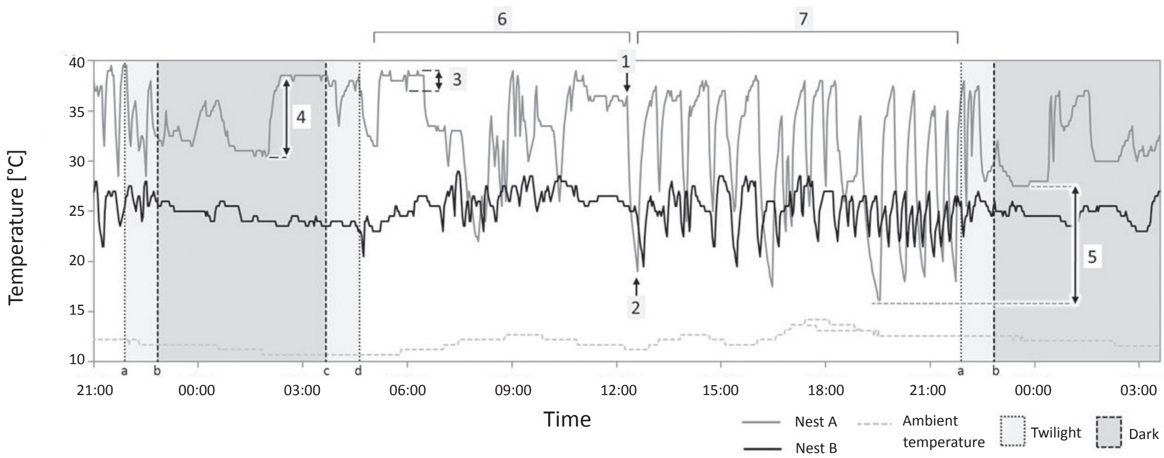

Fig. 8: Example temperature data from two whinchat nests collected over a 30-hour period from 28th to 30th June 2016. Temperatures were recorded at 2-minute intervals using iButtons placed in the nest-cups. Ambient temperature is given for comparison, along with hours of twilight and darkness as defined by (a) sunset, (b) dusk, (c) dawn, and (d) sunrise. A sharp decrease in nest temperature indicates departure of the female from the nest (1), with a sharp increase in temperature on her return (2). Small temperature variations (3) were assumed to be due to behaviour at the nest. Nocturnal variations in temperature were evident (4), but the minimum temperatures reached at night were less severe than those recorded during the day (5) suggesting nocturnal presence of the female at the nest, but reduced contact with nest contents. Mean, minimum and maximum nest temperatures differed between nests. A minimum temperature change threshold was selected for each nest based on the overall range in nest temperatures to aid in the identification of departures; 4 and 1.5 °C for nests A and B respectively. There were some difficulties in interpreting the data during periods of less regular behaviour (6) especially when compared with nocturnal variations. Patterns of behaviour varied through the day, with more time spent on the nest in the first hours after sunrise. In this example, departures from both nests show increased regularity in the afternoon and evening (7). These nests were located less than 5 km apart, and would have been subject to similar weather conditions.

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