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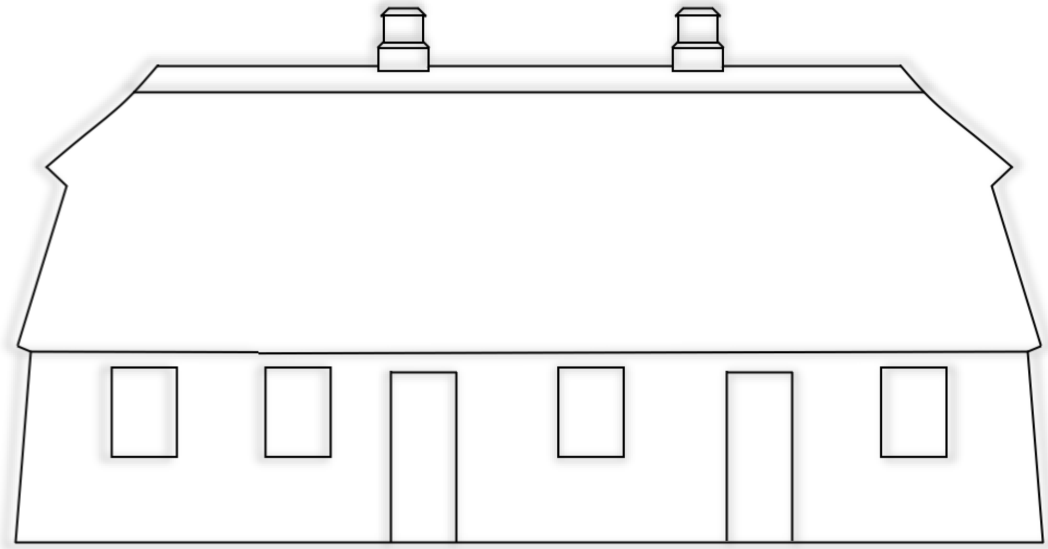

HAS green academy

GEDSER FUGLESTATION

UNIVERSITY OF COPENHAGEN

The physiological differences between long and short distance migratory birds during their spring residence at Gedser Fuglestation

Research Report

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Preface

In the current study short-distance migrators and long-distance migrators were compared to gain insight on their physiological condition during the spring season at Gedser Fuglestation. Fat, weight and age were used as biometrics to analyse the condition of the short-distance migrators of common chiffchaff and Eurasian blackcap, and the long-distance migrators of icterine warbler and lesser whitethroat by using data acquired by bird ringers at the Gedser Fuglestation observatory. The current study was conducted for an internship by Jasper Mosman, who is a B.Sc. student studying Applied Biology at HAS Green Academy in ‘s-Hertogenbosch, The Netherlands. The project was be supervised by Tina Elley, who is the lead member of the steering group of Gedser Fuglestation in Denmark. The project has also been supervised by Nina Goren-Leenders of HAS green academy.

Contents

1. Introduction

As the seasons shift throughout the year, resources such as food become more and less abundant. This shift in availability is an important drive for bird migration (Alerstam & Hedenström, 1998). Their ability to fly makes it easy to cross large distances over a relative short period of time. Individuals of species like the arctic tern (*Sterna paradisaea*) are known to migrate distances of up to 80.000 km annually, as they migrate from pole to pole twice a year (Egevang et al., 2010). The necessity for food and safe breeding grounds makes migration occur across different taxonomic groups, as this phenomenon is mostly seen in raptors, passerines, waterfowl and shorebirds/waders (e.g., Brandes & Ombalski, 2004; Busse, 2001; Si et al., 2015; Piersma, 2007).

Migration takes on different forms and lengths and is often dependant on the needs of specific bird species. There is often a distinction made in birds that are long-distance migrators and short-distance migrators. The differences between species and where they reside during different seasons is generally determined by genetic, social and environmental factors such as weather and habitat quality (Berthold et al., 1992; Sutherland, 1998). Species like the blackcap (*Sylvia atricapilla*) will travel to Southern Europe or Northern Africa (Delmore et al., 2020), while other species such as the European robin (*Erithacus rubecula*) or common chiffchaff (*Phylloscopus collybita*) may not leave the European continent at all, residing in the milder regions of Southern Europe during the winter months (Adriaensen & Dhondt, 1990; Catry et al., 2005). Species like the barn swallow (*Hirundo rustica*), Icterine warbler (*Hippolais icterina*) and lesser whitethroat (*Curruca curruca*) will travel from Northern Europe all the way to the southern parts of Africa for their migration (Burman et al., 2018; Zduniak & Yosef, 2012), making them long-distance migrators.

In order to travel long distances, birds will need a significant amount of resources to make their migration viable, often through the use of stopover sites along the way. Passerines that cross the Sahara desert generally maintain a fat deposition of 40% to 70% of lean body mass (Alerstam & Lindström, 1990). Most of these fat stores have to be acquired before their initial flight that starts their migration, but as long-distance migrators that breed in Northern Europe cross more ecological barriers (such as the Sahara desert or Mediterranean sea) than short-distance migrators, they need to have an adequate amount of stopover sites to maintain their energy reserves (Moore & Kerlinger, 1987). The amount of refuelling needed to make migration viable is not only based on the abundance of food in stopover sites, but also weather conditions and the age of individuals (Visser & Both, 2005; Woodrey, 2000).

The physiological conditions of birds are studied through use of ringing stations across the world. On the southernmost tip of Denmark on the Island of Falster lays Gedser Fuglestation. Migratory birds that are caught and measured here will stay here to breed during spring or continue their migration further north. This makes Gedser an important location for the collection of data on bird migration, as it will be the entrance into Scandinavia for lots of individual passerine birds.

By comparing the biometrics of fat, weight and age between short-distance migrators and long-distance migrators insight can be gained in the physiological conditions of these migratory groups at Gedser Fuglestation in the spring seasons of the years 2013 to 2023. For the entire period of 2013 to 2023 and for each year individually common chiffchaff and Eurasian blackcap are used as representatives for short-distance migrators, and icterine warbler and lesser whitethroat are representative of long-distance migrators.

2. Material & Method

2.1. Area description

Gedser Fuglestation is located at the southernmost tip of Denmark, on the island Falster. The catching and ringing of birds was done in the direct vicinity of the bird station. The area has a total of 27 nets, 25 of which are part of the standard ringing protocol, accounting for a total of 285 meters of net (Figure 2; table 1). The remaining two nets are not part of the standard as they have bigger mesh and are therefore more suitable for catching birds of prey (or “raptors”). The 25 standard nets are placed between hedges that are mostly made up of Blackthorn (*Prunus spinosa* L.), Common Hawthorne (*Crataegus monogyna* Jacq.) and a species of Blackberry (*Rubus* L.) (Figure 1) these plants provide shelter for birds and act as a food source, both directly and indirectly by means of pollinators.

Figure 1 *Photographs of three common plants that make up the hedges in the garden of Gedser Fuglestation.*
A = Blackthorn (Prunus spinosa L.), B = Common Hawthorne (Crataegus monogyna Jacq.), C = Blackberry (Rubus L.)

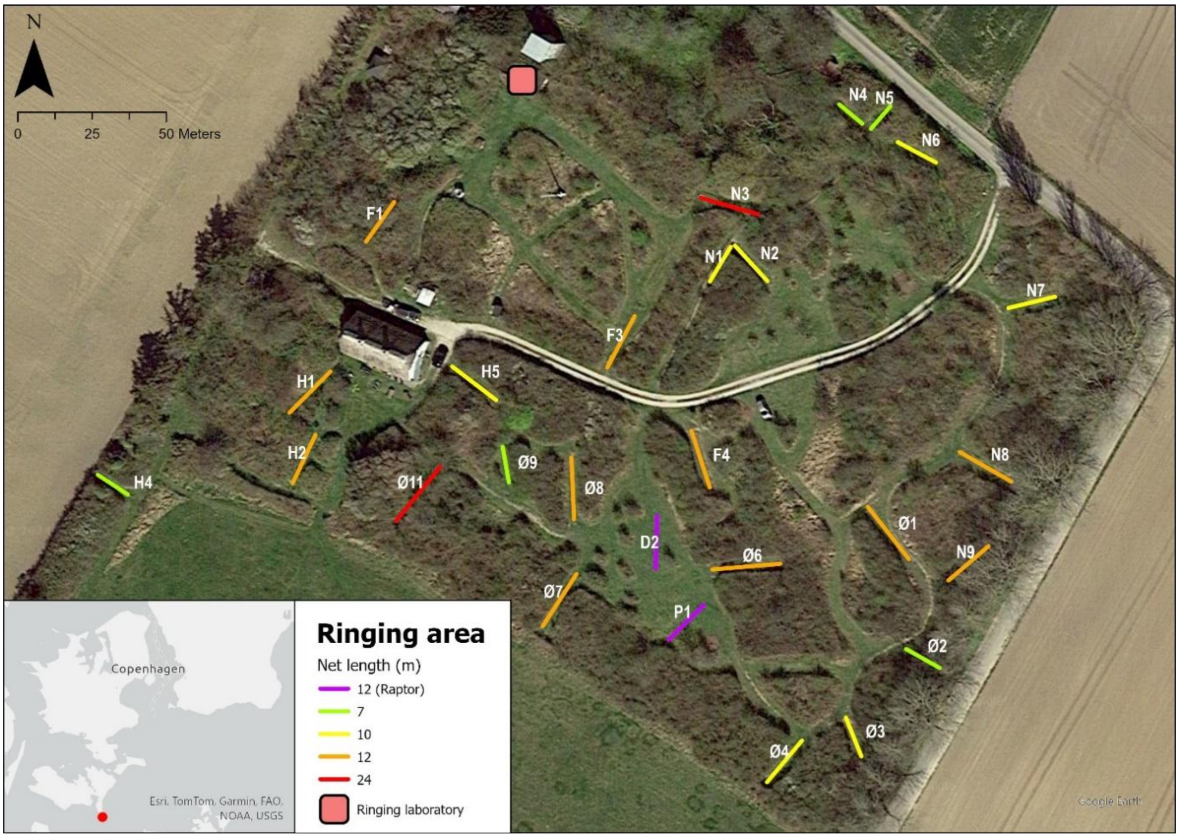

Figure 2 *A map showing the area around Gedser Fuglestation including the locations of the nets and the ringing lab. Net length is indicated by color; green=7m; yellow=10m; orange=12m; red=24m; purple=12m (raptor nets). (Net length is only indicated through color, length is not accurately represented through use of the scale bar.)*

Table 1 *This table shows the order in which the nets are checked, the codes used for each individual net, the length of these nets and whether they are included in the ringing standard.*

Order	Net ID	Length (m)	Standard
1	F1	12	Yes
2	H1	12	Yes
3	H2	12	Yes
4	H4	7	Yes
5	H5	10	Yes
6	Ø11	24	Yes
7	Ø9	7	Yes
8	Ø8	12	Yes
9	Ø7	12	Yes
10	D2	12	No
11	P2	12	No
12	Ø6	12	Yes
13	Ø4	10	Yes
14	Ø3	10	Yes
15	Ø2	7	Yes
16	N9	12	Yes
17	Ø1	12	Yes
18	N8	12	Yes
19	N7	10	Yes
20	N6	10	Yes
21	N5	7	Yes
22	N4	7	Yes
23	N3	24	Yes
24	N2	10	Yes
25	N1	10	Yes
26	F4	12	Yes
27	F3	12	Yes

2.2. Ringing standard

Ringing at Gedser Fuglestation was done annually between the 1st of March and the 15th of June. These dates mark the usual spring period in which normalized ringing and data acquisition take place. The autumn period is marked between the 20th of July and the 15th of November, but data from this period has not been used for the current study. In accordance to the standardized ringing protocol at Gedser Fuglestation (Appendix 1), ringing was done every day for a period of 5 hours starting shortly before sunrise. Ringers at Gedser were required to be in possession of an appropriate ringing license and thereby adhere to rules and guidelines as noted by the University of Copenhagen and the Danish Zoological Museum (Appendix 2), as well as the standardized ringing protocol as set up by Gedser Fuglestation (Appendix 1). During ringing a standard form was used to note the biometrics on (Appendix 3).

The current study makes use of data collected on the species of common chiffchaff, Eurasian blackcap, icterine warbler and lesser whitethroat during the spring periods of 2013 through 2023. Common chiffchaff (n = 1552) and Eurasian blackcap (n = 767) were used as representatives for short distance migratory birds (n = 2319). Icterine warbler (n = 671) and lesser whitethroat (n = 1520) were used as representatives for long distance migratory birds (n = 2191). Biometrics were noted down on standardized data sheets (Appendix 3) that requires a ringer to note down the ring number, date, time of capture, ring license number, species, age, sex, wing length, weight in grams and fat scores. Separate sheets were used for newly ringed birds and recaptured birds. Recaptured birds consisted of all birds that have already been ringed upon capture, regardless of the location where the bird has been ringed originally. The data utilized for the current study consisted of data collected on newly ringed birds as well as recaptured birds. Whenever a bird was captured twice in a single day it was released directly upon its recapture. The data acquired from the database at Gedser Fuglestation was nevertheless filtered to ensure no data was used of the same bird on a given day. Individual birds that were recaptured on different days were kept.

2.3. Biometrics

The acquisition of biometric data was done through methods as described in Svensson (1992). The standardized data sheets (Appendix 3) required ringers to note down data regarding the age, sex (if possible), fat score, wing length (mm), and weight (g). The current study only utilized data regarding the age, fat and weight of the birds.

2.3.1. Measuring fat

Fat was measured according to fat scores which range from 0 to 9. 0 was hereby the lowest amount of fat and 9 was the highest amount of fat (Figure 3). In order to estimate fat scores ringers were to hold a bird on its back and blow the feathers aside to reveal the body underneath. Fat scores are based on the yellow colorations on the bodies of birds, as well as the visibility of internal organs such as the intestines and liver. The amount of yellow coloration around the throat, breast and lower abdomen and thereby the visibility of internal organs determines which fat score was attributed to an individual bird. When internal organs were still visible and fat was mostly deposited around the throat and abdomen a score between 0 and 5 was noted down. In case no internal organs were visible and fat deposits became visible around the breast a score between 6 and 9 was attributed to the bird.

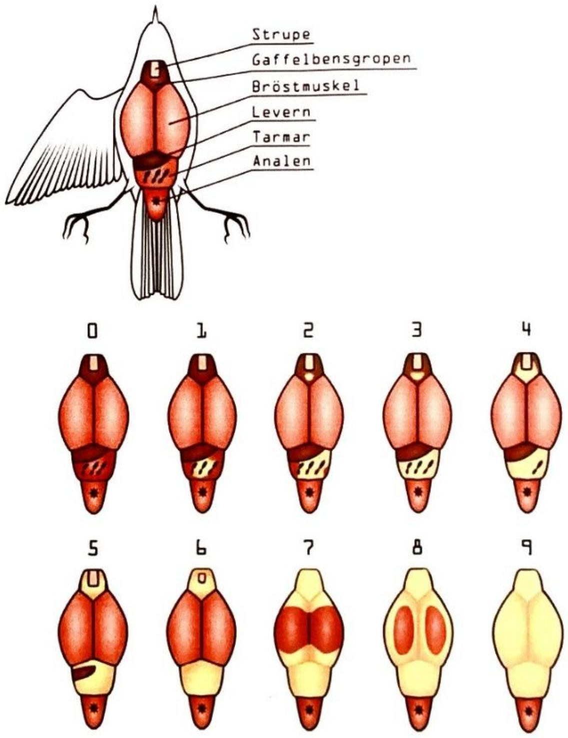

Figure 3 *The fat scores by which fat measurements are taken. 0 = Least amount of fat, 9 = Most amount of fat*

2.3.2. Measuring weight

Weight was measured by use of an OHAUS CL Series Portable Balance (OHAUS, 2008). Birds were weighed by zeroing the balance to a plastic tube with a width of 3 cm. Birds were placed headfirst inside the tube to prevent them from flying away after which the weight was measured in grams.

2.3.3. Measuring age

Birds were aged through inspection of wing and tail feathers and noted down by the calendar year as seasonal changes influence the moulting of feathers. In certain species other physical characteristics such as age related coloration could provide insight on age as well . Through the use of the Identification Guide to European Passerines by Svensson (1992) species specific moulting and colorations were checked in order to properly determine the age of individual birds. Birds that hatched in the same year the measurement was taken were considered 1K birds, birds that hatched the year prior as 2K birds and birds that hatched two years prior as 3K birds. Sometimes a “+” was added to signify that a bird hatched *at least* in the same year, one year prior or two years prior. This is done because the combination of moulting, wear and species specific coloration can cause ambiguity.

2.4. Data Analysis

2.4.1. Data transformation

Weight data was transformed from ratio data to an ordinal scale according to species, as each species has a different weight distribution. For each species the minimum weight was subtracted from the maximum weight and the result was divided by 5. This way 5 bins were set up per species in order to allow for direct comparisons in weight distribution between species (Table 2). Age was also transformed to no longer include “+”, 1K+ became 1K, 2K+ became 2K and 3K+ became 3K.

Table 2 Intervals of weight for each species and the "bin" each interval is placed in.

	Weight range per species (g)			
Bin	**Common chiffchaff**	**Eurasian blackcap**	**Icterine warbler**	**Lesser whitethroat**
1	5,4 -> 6,5	14,1 -> 16,3	11,0 -> 12,6	9,7 -> 11,1
2	6,6 -> 7,7	16,4 -> 18,6	12,7 -> 14,3	11,2 -> 12,6
3	7,8 -> 8,9	18,7 -> 20,9	14,4 -> 16,0	12,7 -> 14,1
4	9,0 -> 10,1	21,0 -> 23,2	16,1 -> 17,7	14,2 -> 15,6
5	10,2 -> 11,0	23,3 -> 25,5	17,8 -> 18,9	15,7 -> 16,7

2.4.2. Statistical tests

None of the biometrics of age, weight or fat showed a normal distribution after subjecting the data to a Shapiro-Wilk test. Fat score distribution between short distance migrators and long distance migrators were analysed over the entire period of 2013 to 2023 and for each year individually by use of Mann-Whitney U tests. Fat score distribution between individual species were also analysed over the entire period of 2013 to 2023 through a Mann-Whitney U test. Differences in weight scores were analysed similarly by use of Mann-Whitney U tests. Correlations between fat and age, weight and age and fat and weight were all analysed per species through Spearman's rank correlation. For correlations using weight the original weight in grams were utilized. All analyses were performed through R (Version 4.1.1; RStudio, PBC; Boston, MA, USA).

3. Results

3.1. Fat

A significant difference ($p < 2{,}2e{-}16$) was found between the distributions of fat scores for short distance migrators and long distance migrators for the entire period of 2013 to 2023 (Figure 4).

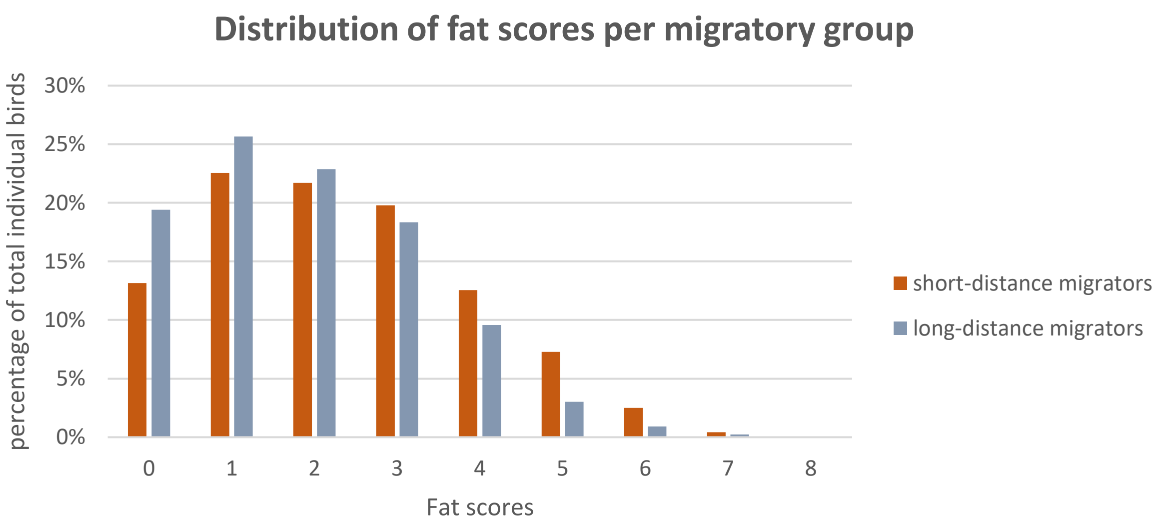

Figure 4 *Distribution of fat scores among short distance migrators and long distance migrators over the full period of 2013 to 2023. With fat scores displayed on the X-axis and the percentage of total individual birds per migratory group on the Y-axis.*

Over the entire period of 2013 to 2023 significant differences were found between all species except for the common chiffchaff and icterine warbler (p = 0,31). Significant differences were shown between the common chiffchaff and Eurasian blackcap (p = 2,3e-05), common chiffchaff and lesser whitethroat (p < 2e-16), Eurasian blackcap and icterine warbler (p = 0,024), Eurasian blackcap and lesser whitethroat (p < 2e-16) and finally icterine warbler and lesser whitethroat (p = 1,4e-15) (Figure 5).

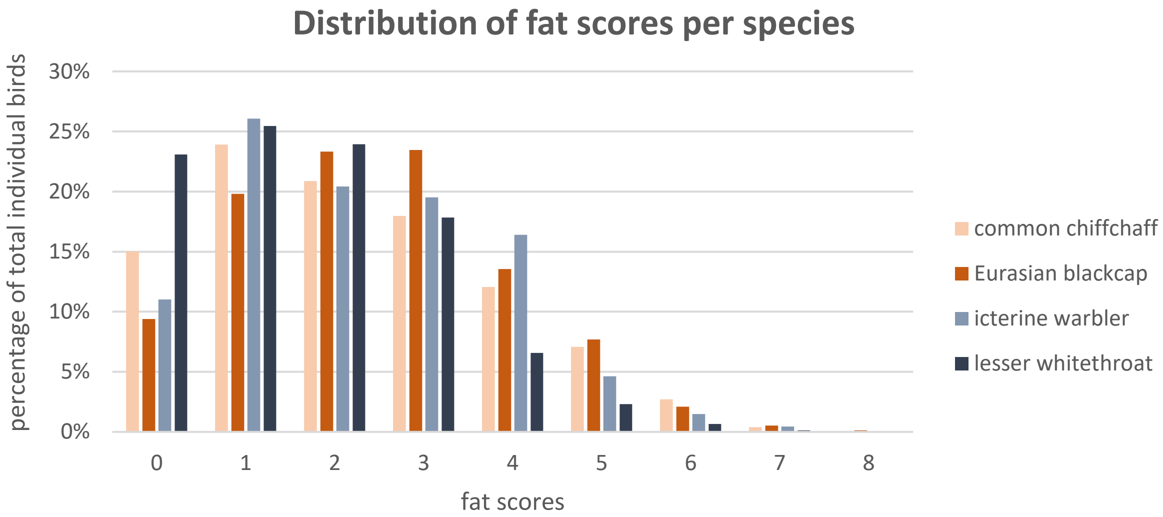

Figure 5 *Distribution of fat scores among the species of common chiffchaff, Eurasian blackcap, icterine warbler and lesser whitethroat over the full period of 2013 to 2023. With fat scores displayed on the X-axis and the percentage of total individual birds per species on the Y-axis.*

Differences in the distribution of fat scores between short distance migrators and long distance migrators were calculated for each year. Two years of which did not show a significant difference, these years being 2013 (p = 0,13) and 2018 (p = 0,59) (Table 3; Figure 6).

Table 3 *A table showing the differences in fat score distribution between short-distance migrators and long-distance migrators for each year between 2013 and 2018. Significance is indicated with *.*

Differences in fat score distribution from 2013 to 2023	
Year	**P-value**
2013	0,1259
2014	4,704e-06 *
2015	5,227e-05 *
2016	0,007731 *
2017	8,165e-08 *
2018	0,5867
2019	0,0008724 *
2020	4,961e-06 *
2021	2,643e-05 *
2022	0,0001894 *
2023	3,449e-05 *

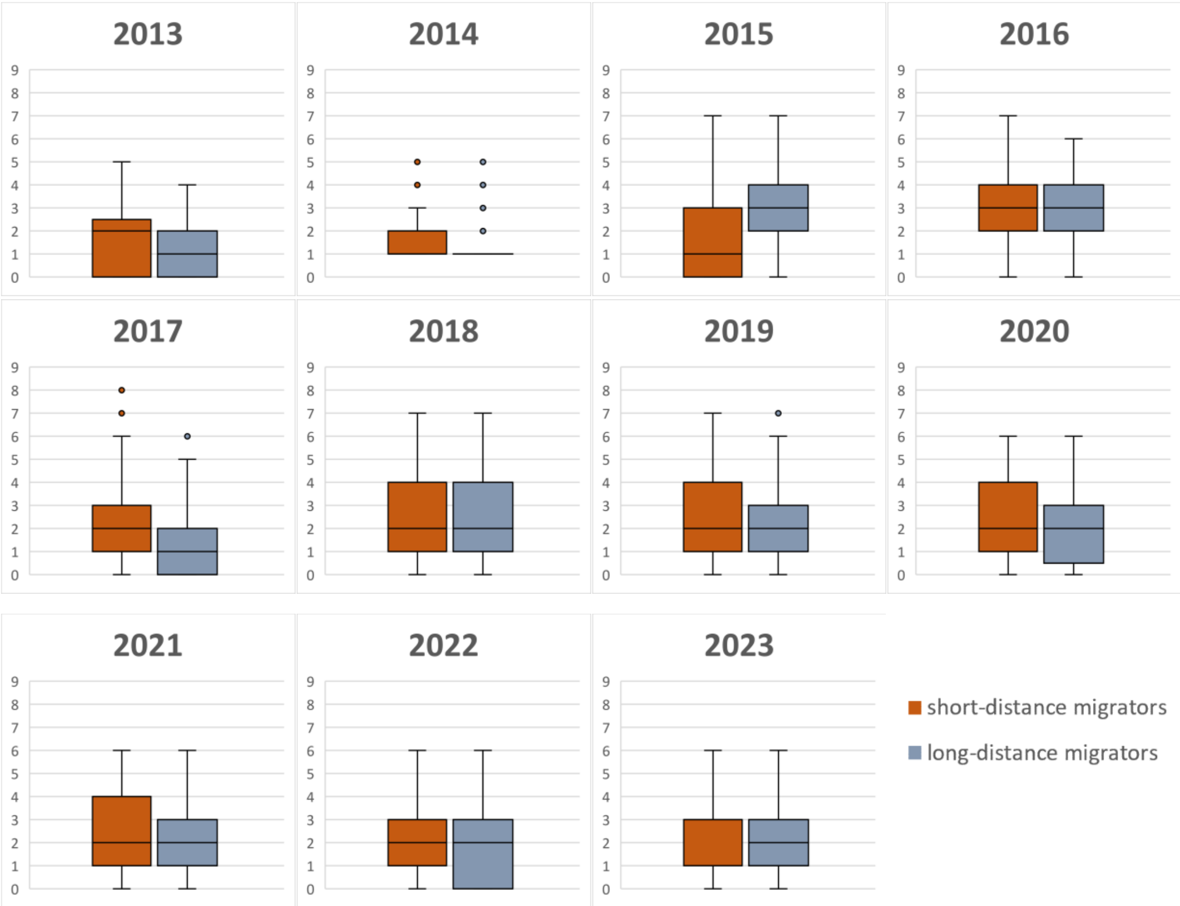

Figure 6 Distributions of fat scores between short-distance migrators and long-distance migrators for each year from 2013 to 2023. Fat scores are presented on the Y-axis. The orange (left) boxplots represents short-distance migrators and the blue (right) boxplots represent the long-distance migrators.

3.2. Weight

Over the entire period of 2013 to 2023 a significant difference was found in the distribution of weight scores between short distance migrators and long distance migrators ($p < 2{,}2e\text{-}16$) (Figure 7).

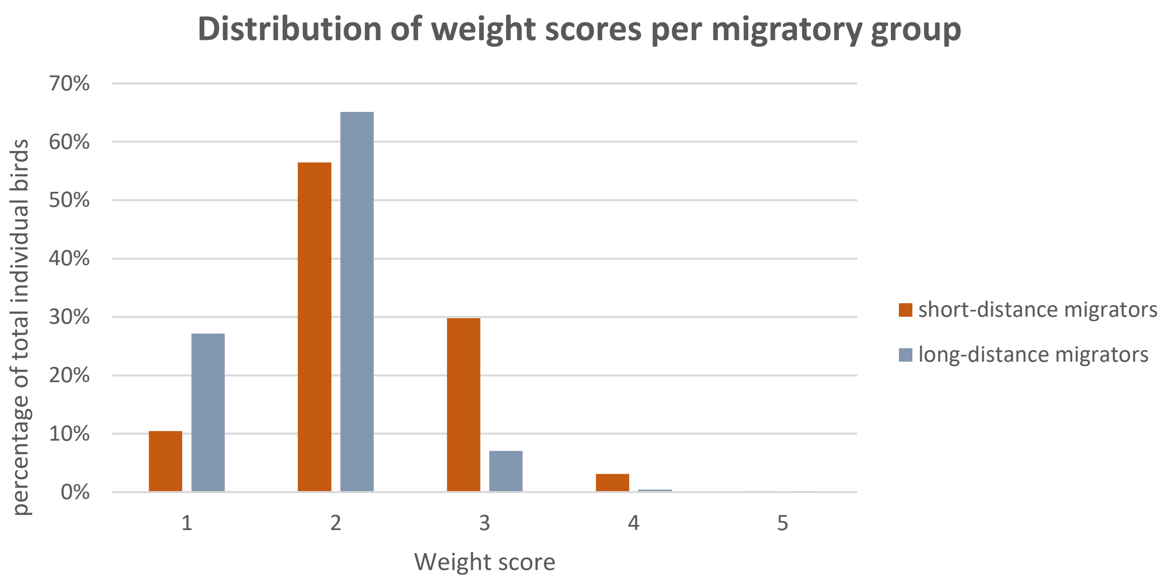

Figure 7 *Distribution of weight scores among short distance migrators and long distance migrators over the full period of 2013 to 2023. With weight scores displayed on the X-axis and the percentage of total individual birds per migratory group on the Y-axis.*

Between most species a significant difference (p < 2,2e-16) was found in the distribution of weight scores except for icterine warbler and lesser whitethroat (p = 0,73) (Figure 8).

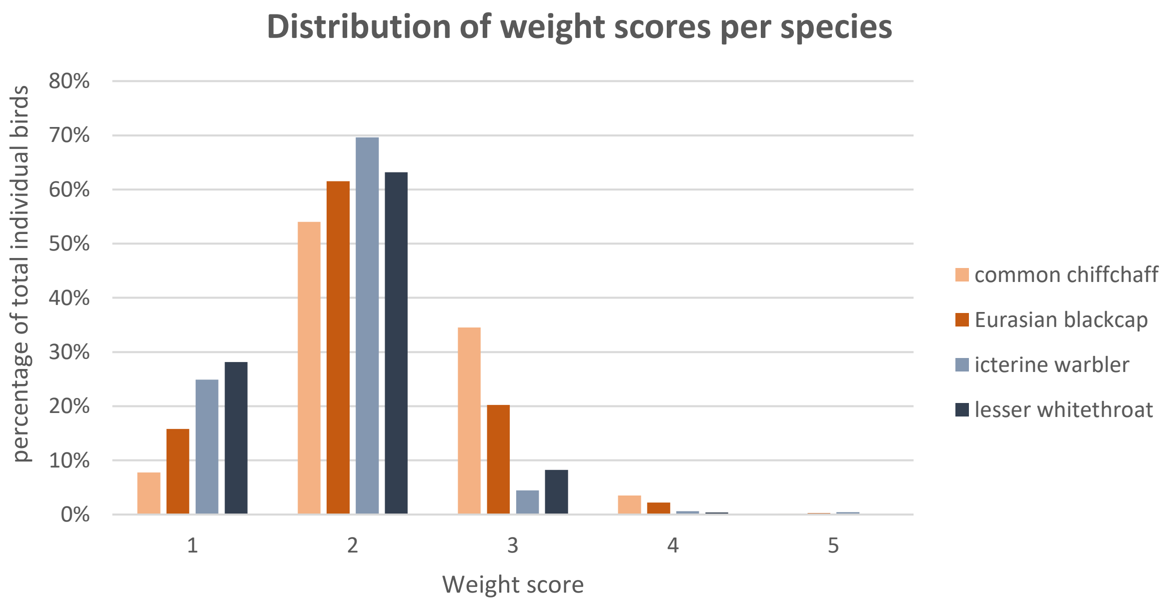

Figure 8 *Distribution of weight scores among the species of common chiffchaff, Eurasian blackcap, icterine warbler and lesser whitethroat over the full period of 2013 to 2023. With weight scores displayed on the X-axis and the percentage of total individual birds per species on the Y-axis.*

For each year between 2013 and 2023 significant differences were observed in the distribution of weight scores between short-distance migrators and long-distance migrators (Table 4; Figure 9).

*Table 4 A table showing the differences in weight score distribution between short-distance migrators and long-distance migrators for each year between 2013 and 2018. Significance is indicated with *.*

Differences in weight score distribution from 2013 to 2023	
Year	**P-value**
2013	0,0002245
2014	6,181e-13
2015	2,964e-13
2016	< 2,2e-16
2017	2,423e-11
2018	1,242e-6
2019	2,462e-13
2020	4,743e-12
2021	<2,2e-16
2022	3,122e-5
2023	1,583e-12

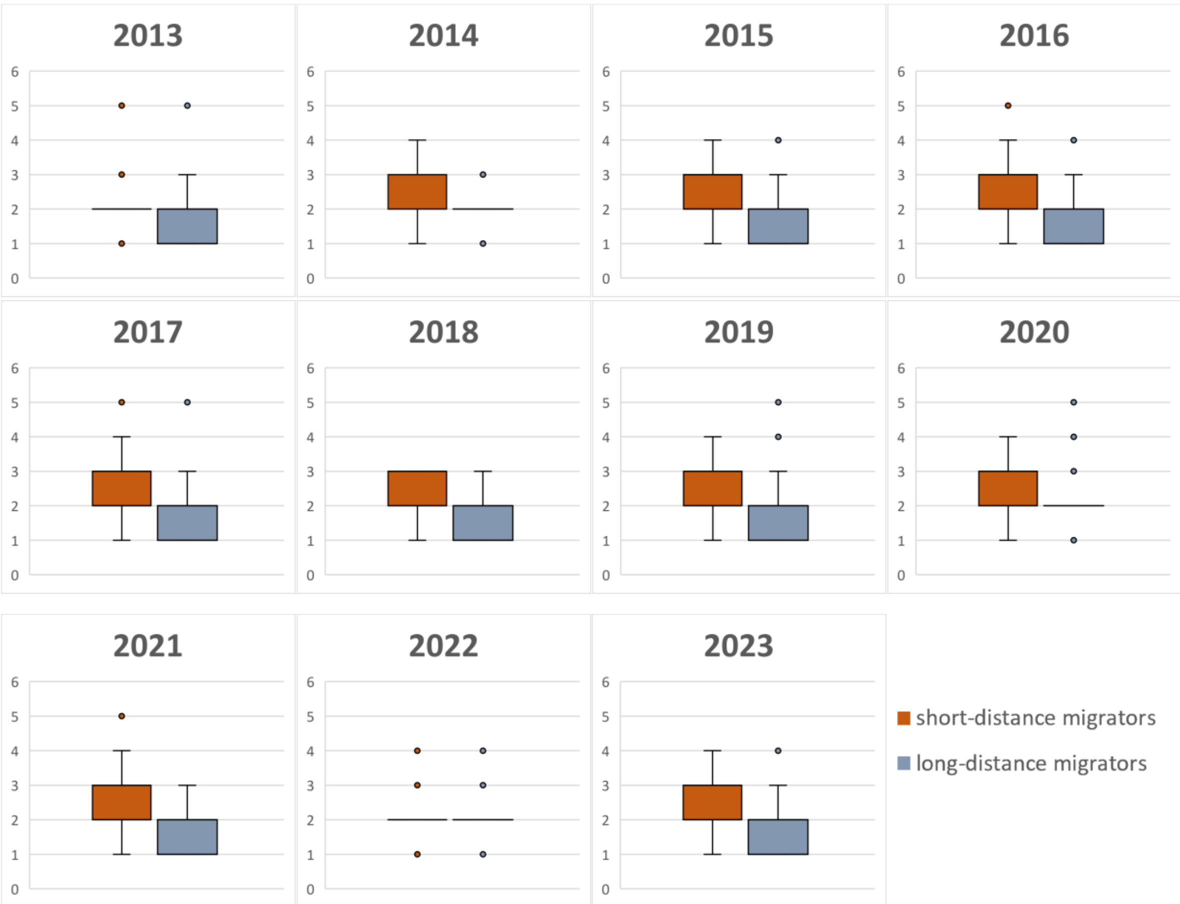

Figure 9 *Distributions of weight scores between short-distance migrators and long-distance migrators for each year from 2013 to 2023. Weight scores are presented on the Y-axis. The orange (left) boxplots represents short-distance migrators and the blue (right) boxplots represent the long-distance migrators.*

3.3. Correlations fat, weight and age

Over the entire period of 2013 to 2023 a weak positive correlation between fat and weight was observed in common chiffchaffs (ρ = 0,26), icterine warblers (ρ = 0,10) and lesser whitethroats (ρ =

0,24) and a moderate positive correlation between fat and weight was observed in Eurasian blackcaps (ρ = 0,49). Despite the correlations being weak to moderate, correlations between fat and weight showed significance in common chiffchaffs ($p < 2{,}2e\text{-}16$), Eurasian blackcaps ($p < 2{,}2e\text{-}16$) and icterine warblers (p = 0,01), but not in lesser whitethroats (p = 0,08) (Figure 10).

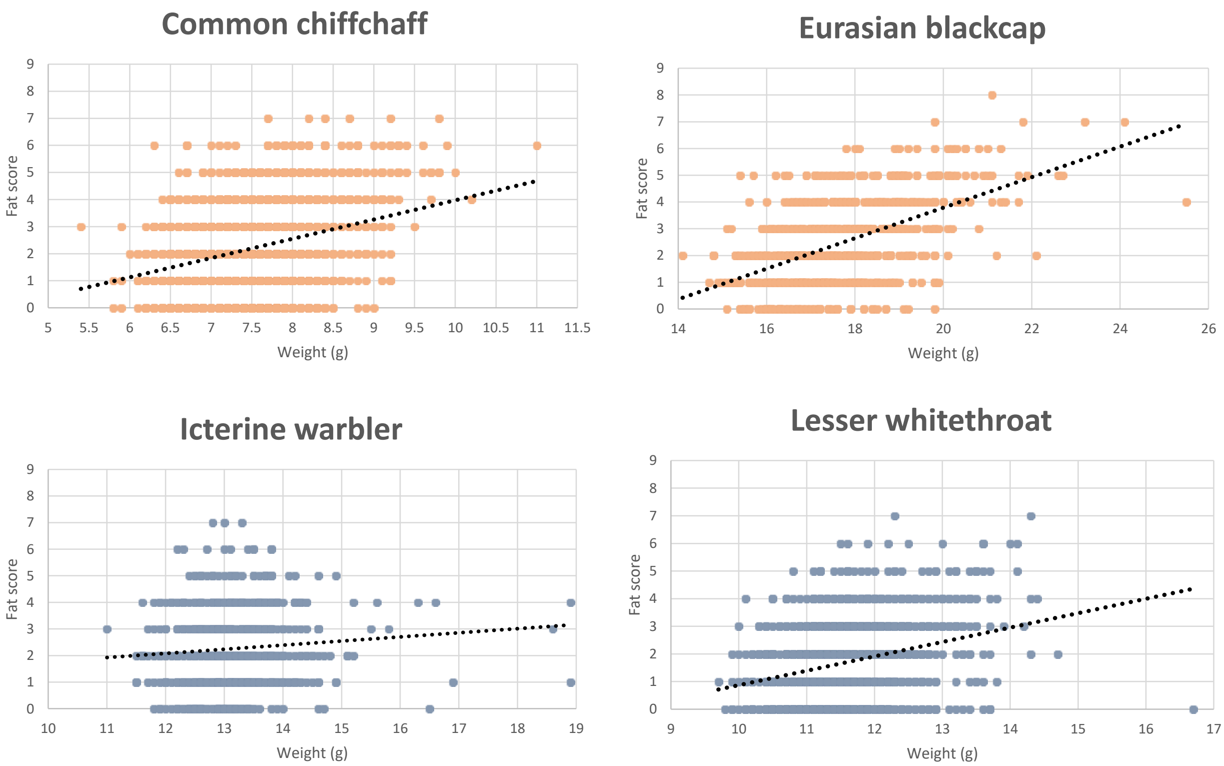

Figure 10 *Correlations between fat and weight in the species common chiffchaff, Eurasian blackcap, icterine warbler and lesser whitethroat. With weight (g) on the X-axis and fat scores on the Y-axis.*

Age and weight showed weak positive correlations over the entire period of 2013 to 2023 in common chiffchaffs (ρ = 0,03), Eurasian blackcaps (ρ = 0,12), icterine warblers (ρ = 0,02) and lesser whitethroats (ρ = 0,04). Correlations between age and weight were not significant in the species common chiffchaff (p = 0,30), icterine warbler (p = 0,55) and lesser whitethroat (p = 0,08). The correlation between age and weight in Eurasian blackcaps was found to be significant (p = 0,001) (Figure 11).

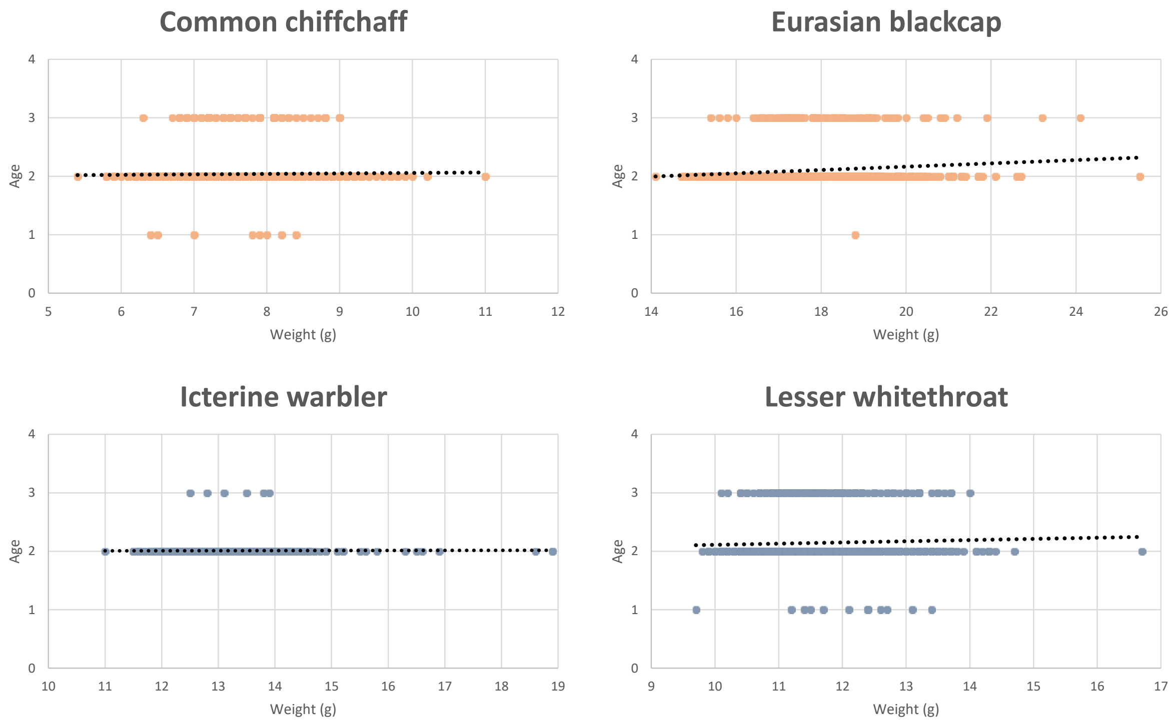

Figure 11 Correlations between age and weight in the species common chiffchaff, Eurasian blackcap, icterine warbler and lesser whitethroat. With weight (g) on the X-axis and age on the Y-axis.

Over the full period of 2013 to 2023 a weak positive correlation was observed in the short distance migrators common chiffchaff (ρ = 0,02) and Eurasian blackcap (ρ = 0,09). A weak negative correlation was observed in the long distance migrators icterine warbler (ρ = -0,02) and lesser whitethroat (ρ = -0,01). These correlations were not significant in the common chiffchaffs (p = 0,40) , icterine warblers (p = 0,67) and lesser whitethroats (p = 0,65), significance was found in the correlation between age and fat in Eurasian blackcaps (p = 0,0087) (Figure 12).

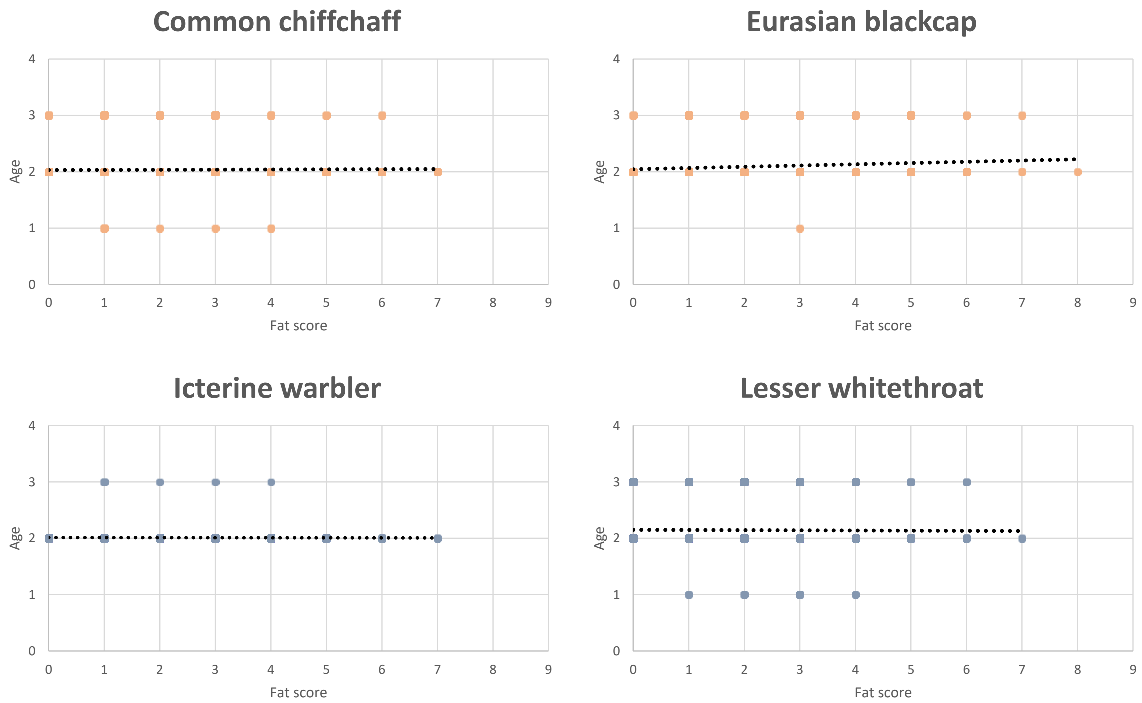

Figure 22 *Correlations between age and fat scores in the species common chiffchaff, Eurasian blackcap, icterine warbler and lesser whitethroat. With fat scores on the X-axis and age on the Y-axis.*

4. Discussion

Long distance migratory birds have lower fat and weight scores upon their capture at Gedser Fuglestation than short distance migratory birds. As long distance migrators stock up on fat before traveling across large ecological barriers such as the Sahara desert, they lose a lot of energy during their continuous travel (Alerstam & Lindström, 1990). They often fly long periods of time without refueling at stopover sites, this causes fat stores to deplete before protein catabolism takes place and a bird will start losing muscle mass (Schwilch et al., 2002). This is especially true for lesser whitethroat, as time-minimization is part of their migration strategy. They will not stop and refuel if they cannot rapidly gain weight at a stopover site, even if their fat stores are already depleted (Zduniak & Yosef, 2012). This could explain why fat and weight do not correlate in this species specifically. This is not observed in the other long distance migrator of icterine warbler. This species has a similar fat score distribution as common chiffchaff, a short-distance migrator. Icterine warblers, as opposed to lesser whitethroats, make heavy use of stopover sites around the mediterranean sea. Common chiffchaffs also occupy this region during winter (Barriocanal & Robson, 2011). Icterine warblers are late migrators and migrate at roughly the same time as melodious warblers (*Hippolais polyglotta*). They face barely any competition from one another as icterine warblers will be more abundant in the eastern regions along the mediterranean, while melodious warblers will occupy western areas (Pilastro, 1998). Icterine warblers generally have their first brood of offspring mid-June, while common chiffchaffs will have had their first brood of offspring in April (Moskát et al, 1993; Forstmeier et al, 2001). By occupying specific regions at specific times around the mediterranean, icterine warblers minimize competition with melodious warblers and common chiffchaff. This could explain why icterine warblers and common chiffchaff share a similar fat score distribution, while icterine warbler and lesser whitethroat do not. The necessity to stock up on fuel before crossing ecological barriers such as the Sahara desert and the mediterranean sea might thereby explain the lack of difference in weight scores between icterine warbler and lesser whitethroat, while differing in fat score distribution.

In direct comparison common chiffchaff and Eastern blackcap seem to share no similarities in fat score and weight score distribution. Eurasian blackcap populations that reside in western Europe during the breeding months tend to remain in southern Europe and northern Africa during the autumn and winter months, making them short distance migrators. Populations that reside in northern and eastern Europe during the breeding months however, tend to travel as far south as south-east Africa, making them long distance migrators. Finally, there are some populations of Eurasian blackcap that spend their winter months in Great Brittain or southwest Scandinavia, including Denmark (Shirihai & Svensson, 2018). The position of Denmark makes it both a northern and western European country and maintains a Eurasian blackcap population even throughout winter. The range of Eurasian blackcap combined with the geographical position of Gedser could potentially allow for a large diversity in the Eurasian blackcap data used for the current study, as opposed to the other species which do not have such a variable range. The diversity in migration distance and range in Eurasian blackcap could therefore not only explain the differences observed in common chiffchaff and Eurasian blackcap, it could also be an explanation for the correlations between age, weight and fat in this species. As Denmark hosts a population of wintering Eurasian blackcaps, this population is not subjected to dangers that come with migration such as habitat degradation and climate change (Bairlein, 2016), allowing certain individuals to become fat, heavy and old.

Overall short distance migrators and long distance migrators seem to differ in their respective fat distributions. This was however not the case for the years of 2013 and 2018. Both of these years held records in regards to weather and temperature. The year of 2013 had an especially cold winter that lasted through march (BBC News, 2013). 2018 held a record for one of the hottest European summers (Copernicus, 2018). These factors could influence the physiological conditions of both short- and long-distance migrators at Gedser.

4.1. Conclusion

Overall, the physiological differences between short distance migrators and long distance migrators do not seem out of the ordinary and are as expected in regards to fat and weight distribution. However, differences and similarities between long distance migrators and short distance migrators seems heavily dependent on the specific species chosen to represent these migratory groups. In order to gain a better understanding of the physiological conditions of these groups more species would have to be included in futures studies. The effects of weather and climate change on different species should also be considered when studying the differences in certain years. Finally, the Eurasian blackcap population at Gedser could be reviewed for their origin and migratory strategies through recapture data, as it is currently unknown whether the Eurasian blackcaps caught at Gedser are predominantly short distance migrators.

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Appendices

Appendix 1

Ringing Protocol

This protocol is intended to inform foreign ringers and local staff on important information regarding bird ringing at Gedser Bird Observatory & Ringing Station. It is requested that all ringers who will carry out standardized ringing at Gedser follow the instructions as stated below to ensure high quality data collection.

Before setting up the nets

The day before ringing it is mandatory to prepare ringing equipment such as rings and data sheets. Weather forecasts should also be checked before nets are set up and during ringing sessions so necessary actions can be taken **before** weather conditions turn bad. Weather forecasts should be checked through the radar, which is available on the website of the Danish Meteorological Institute (dmi.dk/#radar).

Timing and fulfilling the standardized ringing program.

All relevant nets should be set up between 60 to 30 minutes before sunrise. The time of sunrise will be collected for each ringing season from Almanak (suninfo.dk). The first round of ringing should also start within this timeframe and last for a total of 5 hours. In order to fulfil the standardized ringing program there is a minimum requirement of 300 mistnet meter hours. This does not require every net on the premises to be set up, as five 12-meter mistnets would fulfil this requirement.

5 mistnets X 12 meters X 5 hours = 300 Mistnet meter hours

After the standard of five hours has been fulfilled it should be noted down that standard time has ended. **This is important for data registration.**

If weather conditions are unsuitable, there is still a possibility to complete standard ringing. If nets are opened within 2 hours of the normal setup time and remain open for at least 5 hours it still qualifies as standard. The reasoning behind a later setup has to be noted down and added to the notes in the database. If for some reason nets have to be closed when a standard ringing period has already begun, it is possible to complete a standard ringing program if the nets are opened again within an hour. If the nets have already been open for at least 4 hours the data is also still considered a standard ringing session.

Net rounds

After every round the next round should begin 30 minutes after the start of the round prior. Exceptionally a next round can start up to 60 minutes after the round prior has started. Nets should be checked in the following order:

F1 → H1 → H2 → H4 → H5 → Ø11 → Ø9 → Ø8 → Ø7 → Ø6 → Ø4 → Ø3 → Ø2 → N9 → Ø1 → N8 → N7 → N6 → N5 → N4 → N3 → N2 → N1 → F4 → F3

The locations of these nets can be found on a map which is available in the lab and the main building of the ringing station. This map also contains the positions of net E01, P2 and D2 which are not part of the standard ringing program. E01 is located in a field to the southwest of the main building. P2 and D2 are sparrowhawk nets which are not suitable for catching smaller birds due to the size of the mesh. These nets can only be used for the standard ringing program if the netting is replaced with passerine nets and they are changed out before September 1st. After this date the netting should always be replaced with sparrowhawk netting.

Ringing the birds

After birds are extracted from the nets they can be ringed directly at the net, though it is preferred to bag them and take them to the lab for further examination. Birds should only be ringed directly by the nets in the case of an excessive amount of birds. If this is the case ringers should be using a fully equipped ringing waistcoat.

Birds should always be ringed with the appropriate ring size. A list for ring sizes is available in the bird laboratory. If for any reason a different ring sized is used than is recommended a note should be added to the database.

When ringing in the lab it should always be noted down during which round the bird was extracted by writing down the time at which the round was taken. When ringing is done directly by the net this should also be noted down in a provided notebook.

Data registration, methods and biometrics

Standard biometrics include wing length, fat score and weight. These can be noted down on sheets present in the bird lab. Different sheets should be used according to ring size, an entirely separate sheet should be used for recaptures. When ringing is done by the net this information should be noted down in coded notebooks, labels for these notebooks are found in the bird lab.

Standard wing length measurements should be done in accordance to the maximum notch length as stated in "Identification Guide to European Passerines" (page 19 – 21) by Lars Svensson. A diagram on fat scores is available in the bird lab.

Data Entry

All ringing data should be entered into Dofbasen.dk and the Zuschlag's Bird Ringing Database, which is available at the bird station. These programs will be introduced to new ringers upon arrival at the station.

Weather data, net time, net meters etc. should all be entered in the databases even if no birds were ringed. This should also be done if standardized ringing was not achieved, if this is the case the field for "total net meters" should be entered as "0".

Sound system

There are Bluetooth devices available at the station to play bird sounds and manipulate migrating birds to be caught. The use of these devices is not permitted the night before (from 2AM) and during standard ringing times. Always be aware that you are not causing any disturbances to birds, neighbours or visitors. **Always consider animal ethics before turning on the system.**

Other duties

When working as a ringer you are asked to help with gardening, including lawnmowing and the pruning of bushes and trees. Grass underneath nets should be mowed regularly to prevent birds that get caught in the lowest shelf of the nets to get wet and cold.

Ringers at the station are requested to write a daily blogpost highlighting the catches of that day. The blog is read by over 100 people daily during ringing seasons. The blog is an important tool to provide outside public and various organizations with an insight in the station activities.

General advice

The garden is a public area, but certain areas are off-limits to the general public. If visitors that are not connected to the station are walking between the nets they should be guided to areas not restricted to them.

The safety of birds is important. Therefore it is important to never open more nets than is manageable, to never sleep while nets are open and to always keep you cellphone with you in case of an emergency. A list of telephone numbers is always available in the bird lab. When the amount of birds becomes unmanageable, or if a bird seems weak, then birds should be released right away. **Animal ethics always comes first.**

Appendix 2

Bird ringing licenses

In order to be able to ring birds there are different licenses, the holders of theses licenses are granted permissions and responsibilities depending on what license they hold. Licenses are distributed through the University of Copenhagen and the Danish Natural History/Zoological Museum. There are four different tiers in licenses that can be held by a ringer depending on experience. The licenses are marked as X, C, B and A respectively. Both the X and C licenses are for beginners, holders of these licenses are always subject to the supervision of a B or A license holder. Independent ringing is therefore reserved for B or A license holders, but only an A-license holder is allowed to request rings. A-license holders are often overseers for ringing groups or bird station, as they hold full responsibility to report the use of rings to the Zoological Museum of Copenhagen.

License	Minimum age	Permissions and responsibilities
X	16	• License holder cannot request rings • License holder cannot ring independently and is to be supervised by an A-license holder or B-license holder • License holder must keep a record of species taken from nets/traps and species that are ringed. Record must be used and approved by an A-license holder or B-license holder when applying for a C-license.
C	18	• License holder cannot request rings • License holder can ring independently under the full responsibility of an A-license holder or B-license holder. Responsible license holders thereby carry the responsibility to report ringed birds to the Zoological museum and must be present to be called upon for guidance or in the case of emergency. • License holder must keep a record of species taken from nets/traps and species that are ringed. Record must be used and approved by two A-license holders or B-license holders when applying for a B-license or A-license. • License holder must comply with rules in regards to locations and species. • License holder must hold permissions for the use of catching equipment.
B	18	• License holder cannot request rings • License holder can ring independently with rings requested by an A-license holder, who carries the responsibility to report ringed birds to the zoological museum. • License holder must comply with rules in regards to locations and species. • License holder must hold permissions for the use of catching equipment.
A	18	• License holder can request rings for themselves or for use within a ringing group or bird station. • License holder is responsible for the use of requested rings holds the responsibility to report ringed birds to the zoological museum. • License holder must comply with rules in regards to locations and species. • License holder must hold permissions for the use of catching equipment.

Appendix 3

Data collection sheet

Gedser Bird Observatory & Ringing Station

Coding: dd = day, mm = month, yyyy = year

Type of record: ☐ Ringing ☐ Recapture

Ring size:

Correctur stuff

Liebzi rocks

RING no.	dd	mm	yyyy	hour	Licens nr	Species	Age	Sex	Wing	Weight	Fat	Comments	Input	Datacheck
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