

Diurnal broad-front migration over the Creuse (France) in autumn 2022

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1 Introduction

1.1 Background

In 2006 we bought a barn in Sallandrouze, St. Maurice près Crocq, in the Creuse (23). This barn was transformed into a house. In the following years we visited the Creuse a few times a year. Especially in autumn I have looked into the air to see which species I could see migrating. I have registered a day with > 10.000 woodpigeons, >80 red kites, cormorants crossing the region at high altitude, once a Booted Eagle, large flocks of swallows. Although these were nice observations, which I enjoyed, I had no idea about the general patterns in the autumn migration in these region: species composition, numbers and timing. Furthermore, in the literature only fragmented information could be found (e.g. Chaffreix 2007, Sepol 2013, Hemmery & Balize 2013). With this in mind, I decided to spend a an autumn in Sallandrouze to register the visible migration by daily counts. To keep the amount of work to be done limited I split this project into two parts; one year to register the short distance migration (half September – end November) and one year for the long distance migrants (end July – beginning October).

Counting visible bird migration has a long history in my home country The Netherlands. In the forties and fifties of the previous century the Chaffinch and Starling were model species to understand the strategy of diurnal migrants along the coast of the North Sea (leading line migration) and away from the coast (inland broad-front migration). Both species are numerous migrants all over the country. Much of the research was published in Gruys-Casimir (1965). This work was the starting point of the Working group on counting visible bird migration in The Netherlands (LWVT). The main goal of this group was to quantify amount, timing and direction of migration of different species over The Netherlands in spring and autumn and regional differences on these aspects. A summary over the years 1976-1993 was published in 2003 (Lensink *et al.* 2003). In 1993 the working group ended his activities. In these years the digital possibilities expanded and observers of visible bird migration gathered on the digital platform trektellen.nl. Since then the number of sites and observers increased rapid. Nowadays in autumn more then 75 sites are active on a daily basis. In 2004 trektellen.nl changed into trektellen.org and became international with for instance observation sites in France.

During the years 1975-1993 counts of visible migration in The Netherlands were conducted according to a clear protocol. In this protocol counts in the early morning, starting half an hour before sunrise and lasting 10 quarters, were the basis in this project. Counts itself were done with eyes and ears, with the help of binoculars for exact counting. Furthermore observations were divided into birds passing by within a circle of 100 m around the observer and birds passing by outside this circle. After 1993 most the protocol was left behind and starting time and length of the counts were more variable and most sites skipped the use of a circle of 100 m. Besides, in the first years trektellen.nl did not facilitate such details in data sampling.

In the Netherlands I took part in daily counts in the early morning in the autumns 1981-2003 near Arnhem, with more than 100 counts between half of August and the end of November each year. With this experience in my pocket I started counts of visible bird migration at Sallandrouze in autumn 2022.

1.2 Questions

Counts of visible bird migration were done to get insight in:

- species composition
- number of birds
- direction of migration
- flying height
- behavioural aspects

In order to get a proper insight in these aspects I used the same protocol I used in The Netherlands.

In this report a brief summary is given on the aspects mentioned before. I start with a summary on site, weather, methods in the field and behind the desk.

2 Site, weather and methods

2.1 Site

The observation site is located just north of the hamlet La Sallandrouze (St. Maurice pres Crocq) (45.50.52,59 N 2.18.35,71 E). This area is part of the northern range of the Massif Central as well as the Parc Regional du Plateaux de Millevaches. In La Sallandrouze le Ruisseau de Chancet flows from east to west. Near Pontcharraud, 5 km to the west, this ruisseau comes into La Rozeille, which flows into the river Creuse 2 km south of Aubusson.

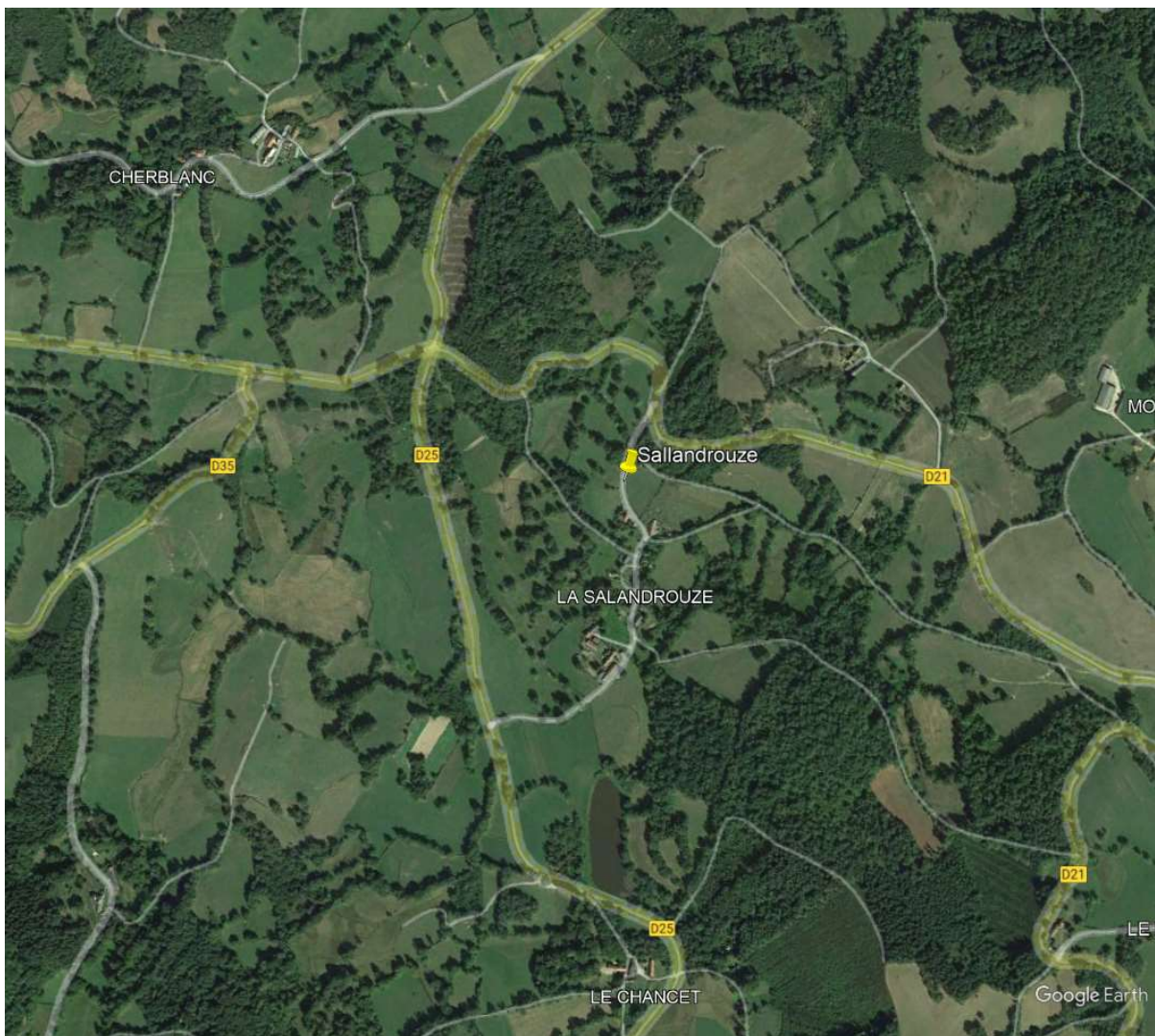


Figure 2.1 Location of the observation site Sallandrouze (yellow pin) (Google Earth).

The observation site is located on the northern slope of the Ruisseau du Chancet. To the west there is a perfect view over the valley of the Ruisseau up to 6 km away. To the south the view is at least 1500 m and to the east at least 500 m. To the north the view is limited to about 100 m, due to the forest edge and the upgoing slope of the valley.

In the mountainous landscape in this part of the Creuse, the agricultural land use is grassland for beef cows interspersed by forests, wooded banks, hedges and clumps. Originally Oak *Quercus robur* was the dominant tree species. After WW II a part of the oaks was replaced by Norway Spruce *Picea picea* and Douglas Fir *Pseudotsuga menziesii*. Outside the forests oak is still dominant.

La Sallandrouze is 630 m above sea level. Nearby the mountains rise up to 800-900 m height. Further south at 25 km, the Plateaux du Millevaches reaches 1100 m above sea level.

2.2 Weather

Data

On site information about cloud cover, visibility, precipitation and sunshine was sampled.

Cloud cover in eighth, e.g. 0/8, 1-8, , 8/8.

Visibility, 0 = clear, 1 = light misty, no hinder, 2 = strong misty, some hinder, 3 = ground mist, 4 = light fog, hinder outside 100 m, 5 = moderate fog, hinder outside 100 m, 6 = heavy fog, hinder within 100 m.

Precipitation, type of rain and duration (% of 15 minutes)

type 1 = light drizzle, paper gets wet, 2 = heavy drizzle, 3 light rain, 4 = rain, 5 = intense rain, 6 = downpour, time to go home.

Sunshine

Visibility of the sun in % of 15 minutes

Temperature

Noted at the beginning and end of the count; figures found on France-meteo.

Wind

Wind direction and speed (in Beaufort), found on www.buienradar.nl/europe.

Weather in autumn 2022

Since climate change became reality the year round temperature in the Creuse has increased with 1-2 °C. Summer 2022 was warmer and drier than the long term average. The warm and sunny weather continued far into autumn, with much sun and less precipitation compared to the long term average. In October the average temperature at the beginning of the day was 11,4, against 6,4 as long term average (*cf.* <https://www.weather-atlas.com/en/france/la-creuse-climate>). The average maximum at the end of the count was 19,2 °C, against 14,4 °C as long term average. This huge difference between the long term average and the temperature in 2022 continued into the first half of November. The second half of September was relative cold compared to the monthly average (14,7 °C against 19,2 °C).

On most days between 16th September and 14th November the weather was calm and relative warm. In the second half of this period there were many days with wind from the south; an opposite wind for birds. Tail winds were scarce in autumn 2022, but in the first half of the study period there were some days with side winds from the east. Many days started with hardly no wind. On such days after

2-3 hours wind started quit rapidly to blow. Rainy days were scarce, especially with rain for many hours. On many days there was a veiled sky, with the sun most of the time visible.

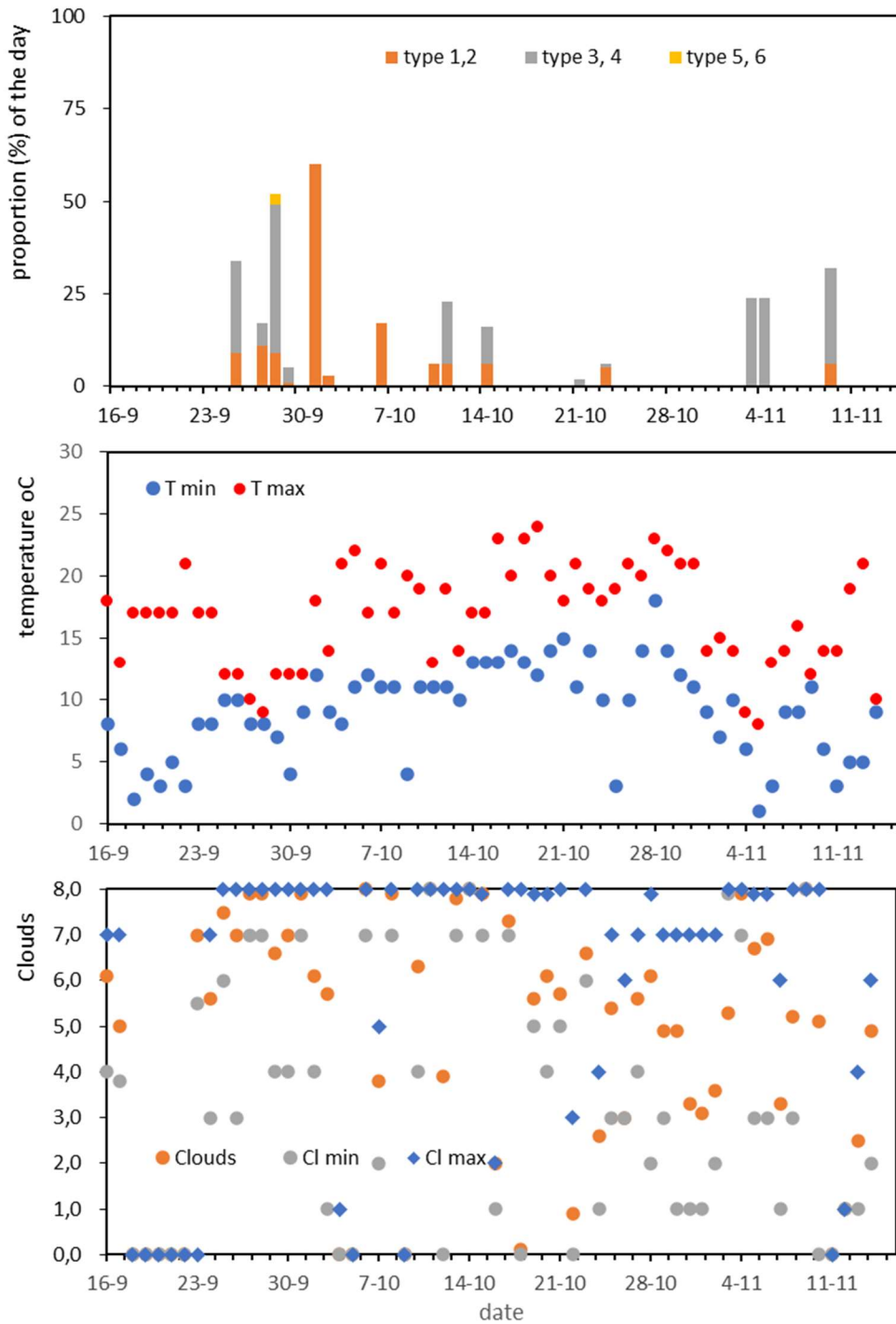


Figure 2.2 Precipitation (duration), temperature (minimum, maximum), cloud cover (average, minimum and maximum during a quarter) between 16 September and 14 November 2022.

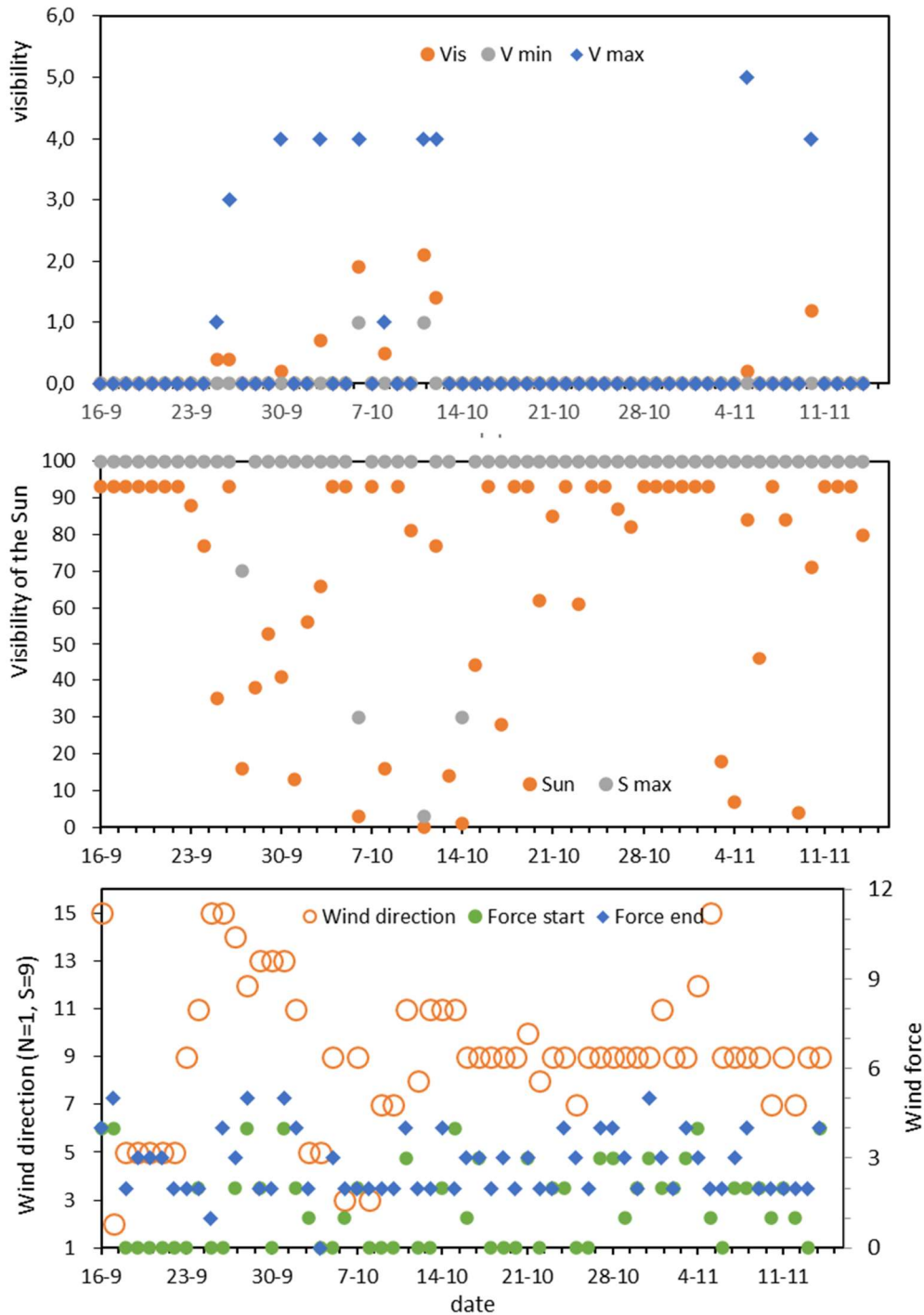


Figure 2.3 Visibility (average of all quarters, minimum & maximum during a quarter) and sunshine (during 30 quarters, maximum during a quarter), wind direction and wind speed (beginning and end of the count) between 16 September and 14 November 2022.

2.3 Methods in the field

Around the observation site a circle of 100 m was drawn. Outside this circle only information on species and number was sampled (and noted). Within this circle information on species, number, flight direction, flight height, flock formation, flight behaviour and type of observation was sampled

(and noted, appendix 1 for an example). For raptors and some scarce species this detailed information was also sampled for birds outside the 100 m circle. Notation per quarter.

100 m circle

In the field the circle was recognizable on landmarks like specific trees and buildings.

Species

Each passing flock was determined, based on form, speed, characteristics and call, see Gatter (1976, 2000). Mixed flocks were noted as such.

Number

Small flocks were counted one by one, medium sized flocks ten by ten, large flocks hundred by hundred, very large flocks by thousands.

Direction

Flight direction was noted in 16 directions, e.g. S, SSW, SW, WSW, etc. In the field directions were recognizable on landmarks like certain trees.

Flight height

The height, above ground level, was noted in 8 classes: 1 = 0-2 m, 2 = 2-10 m, 3 = 10-25 m (into the crown of trees), 4 = 25-50 m (well above trees), 5 = 50-100 m, 6 = 100-200 m, 7 = 200-500 m, 8 = >500 m. For class 5 and higher the noted height is an estimate, based on 40 year experience with counting visible bird migration.

Flock formation

Formations like front, elongated, ball, disk, line and V. Formations like a front or stretched can be weak or strong.

Flight behaviour

Among the small species flocks can fly in about a straight line or in one direction with small corrections on direction (like swallows do). Raptors, storks and cormorants can use flapping, gliding and soaring or combinations.

Type of observation

Three types of observation are distinguished: bird only heard (bird not found, mainly during the first 25 minutes), bird heard and seen, bird only seen.

2.4 Time schedule of a count

Counts started half an hour before sunrise exact. The moment of sunrise was found on the website of France-meteo. Most days counts lasted 30 (7,5 hours) or 32 quarters (8 hours). On most of these days migration intensity minimized 6 or 7 hours after the start. If migration intensity was still notable, the count was extended for 1 or 2 hours. Also on some days in November with nice weather reaching till far north. On such days cranes could be expected in the (late) afternoon; having started at Lac du Der in the early morning.

Counts on a day were divided into 4 parts:

quarter 01-10 early morning

quarter 11-20 late morning
 quarter 21-30 early afternoon
 quarter 31-40 late afternoon
 quarter 01-40 whole day

These terms are also used in the results.

In total 464,5 hours have been covered by counting migration, of which 150 hours in the early morning, 146,5 in the late morning, 136,5 in the early afternoon and 31,5 hours in the late afternoon.

2.5 Methods to characterize migration

Number of birds

Data are sampled on a weekly basis. In this research I counted seven days a week, so no correction is needed to make weeks comparable. Only the first week (1 count) and the last week (3 counts) are incomplete. Data can be corrected for the counts missing. After correction weekly totals can be summed to a seasonal total. This can be done for counts of 10 q in the early morning and counts lasting a bigger (standardized part) of the day.

$$\text{EST} = \frac{a}{b} (\text{weekly total} / n \text{ counts a week}) * 7$$

Whereas EST is the extrapolated seasonal total; a = the first week with counts and b = the last week with counts.

The number of birds of a single species one counts on a single day, or on a series of days, is an indication for the numerousness of a species on migration. At the same time it isn't fair to compare the total number of a small species with the number of a large species. Very small species are seen till about 100 m away from the observer (with the naked eye), whereas large species can be noticed at kilometers distance. Also, large flocks can be noticed at greater distance compared to small flocks or single bird flocks. To make the numbers of different species comparable, I used the proportion of birds seen in a circle of 100 m around the observer.

$$\text{SEST} = ((\text{EST} * \% \text{WD}) / 100) * 5$$

Whereas SEST is the standardized extrapolated seasonal total; e.g. the number of birds passing over an axis of 1 kilometer; %WD is the proportion of birds with a direction; e.g. the proportion passing within a circle of 100 m around the observer (axis is 200 m).

Timing of migration

The timing of migration in autumn can be described by calculating the date 10, 25, 50, 75 and 90% of the total has passed; expressed as D10, D25, etc. The date with the first and last observation are expressed as D0 and D100.

The length of the migration period in days can be expressed as

The full migration period (FMP) = D100 - D0

The Main migration period (MMP) = D90 - D10

The Top migration period (TMP) = D25 - D75

Direction of migration

The direction of migration is characterized by two measures:

The average direction of migration and the rate of concentration around the average.

$$\tan a_o = \frac{\sum_{l=1}^{16} n_i * \sin a_i}{\sum_{l=1}^{16} n_i * \cos a_i}$$

$\tan a_o$ = tangens of the average direction of migration

n_i = number of birds in direction i

$\sin a_i$ = sinus of direction i

$\cos a_i$ = cosinus of direction i

$$\tilde{a} = \frac{1}{n} \sqrt{\sum_{l=1}^{16} n_i * \sin a_i)^2 + \sum_{i=1}^{16} n_i * \cos a_i)^2}$$

\tilde{a} = rate of concentration around the average direction

n = number of birds with a direction (within 100 m of the observer).

Altitude of migration

Based on the eight height classes the 10%, 50% and 90% percentiles can be calculated. For instance, if the 50% is calculated at 4,5, it means that the 50% is half way in class 5.

3 Results

3.1 Number of species

In the early morning 53 species were seen migrating between 16 September and 14 November. During the whole day the total ended up at 65 species. In the early morning 5 species were only seen once. Among those species which mainly migrate later on the day using thermals: Black Stork, Hobby, Crane; species which are real scarce like Water Pipit, Ring Ouzel, Redpoll and Cirl Bunting and species which departure sites are located at some distance like cranes. During the whole day only four species were seen once. Among them two species which mainly passes by before 15 September: Booted Eagle and Swift. The Red Footed Falcon is a migrant is really scarce in this region. The Stonechat is mainly a nocturnal migrant and is rarely noticed during the day. On 7 October a Raven was seen in a line of Red Kites migrating at great height SW.

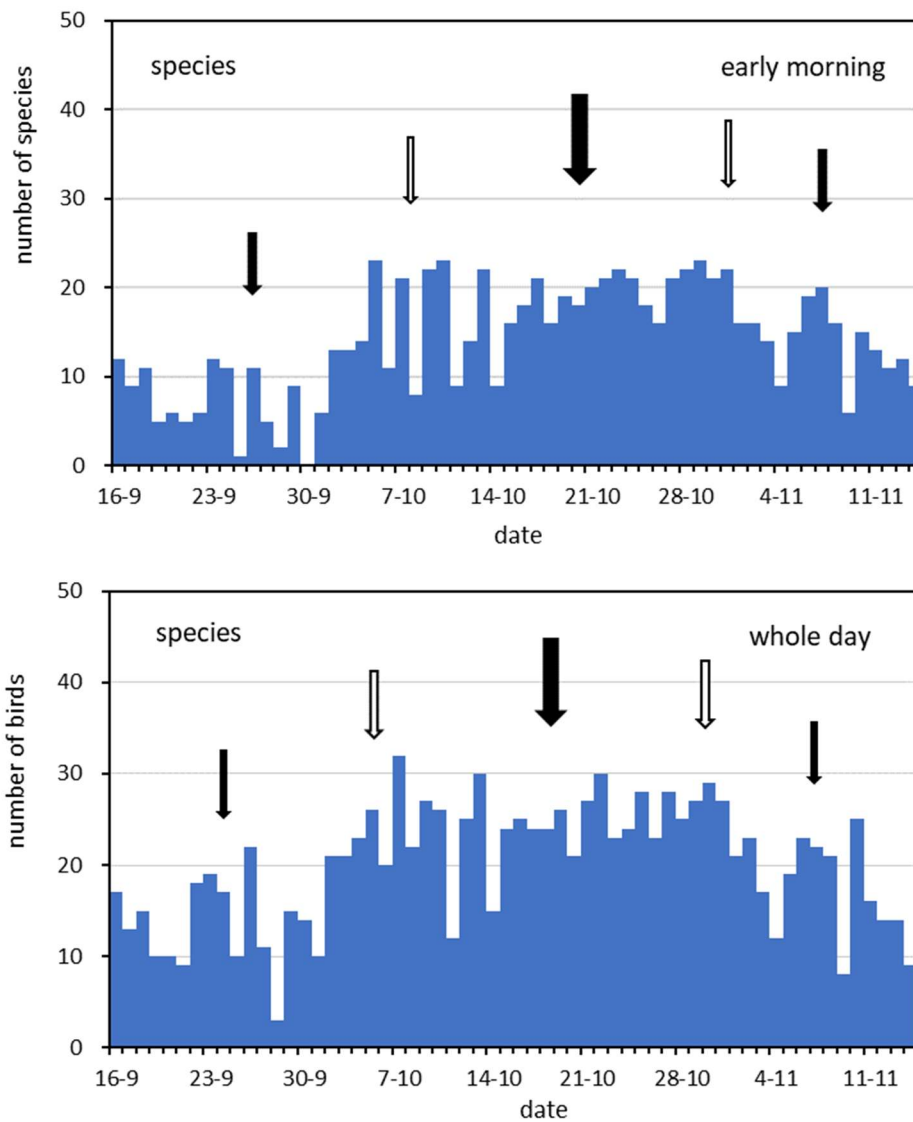


Figure 3.1 Number of species in the early morning and during the whole day. Arrows denote the date on which 10%, 25%, 50%, 75% and 90% species sum has passed.

In October more species were seen during a single count compared to September and November. The maximum in the early morning was 23 species on 5, 10 and 29 October and for the whole day 32 species on 7 October. The maximum is relative early, and falls together with the days that the last long distance migrants pass and most of the short distance migrants have begun their autumn migration.

3.2 Number of birds

In total nearly 450 000 birds have been counted between 16 September and 14 November: 447 534 birds exact. In the early morning the total was 237 183 birds. The most numerous species was the Woodpigeon; 184 337 birds in the early morning and 337 183 birds during the whole day. Second best was the Chaffinch with 32 399 birds in the early morning and 54 218 birds during the whole day (table 3.1).

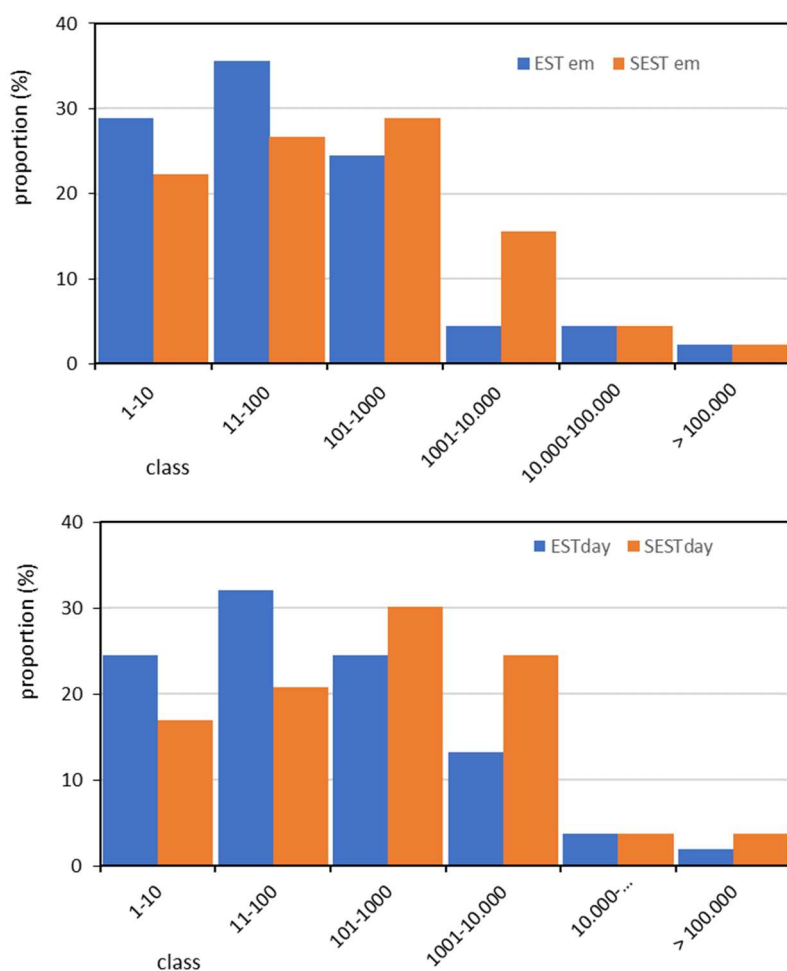


Figure 3.2 Distribution of the short distance migrants over classes of numerosity for counts in the early morning (on top, $n = 45$) and the whole day (below, $n = 53$).

Based on the EST the total number of more than 50% of the species is passing as a migrant with less than 100 birds (figure 3.2) ; both in the early morning and during the whole day. If we correct for differences in size of species, using the proportion seen within a circle of 100 m, the largest class is 100-100 birds, with less than 50% of the species passing with <100 birds. Note that for a whole day two species pass by with >100.000 birds over an axis of 1 km: Woodpigeon and Chaffinch (table 3.2).

Table 3.1 Number of birds seen in the early morning (N), the extrapolated number of birds (EST), the proportion of birds within a circle of 100 m (direction), standardized extrapolated number of birds (SEST). Species ranked on strategy (a = long distance migrant, e = short distance migrant) and alphabet.

		strategy	N	EST em	% with direction	SEST em
Barn Swallow	<i>Hirundo rustica</i>	a	416	488	31,8	776
Black Kite	<i>Milvus migrans</i>	a	1	1	100,0	5
Hobby	<i>Falco subbuteo</i>	a	1	1	100,0	5
Honny Buzzard	<i>Pernis apivorus</i>	a	4	16	75,0	60
House Martin	<i>Delchion urbica</i>	a	716	716	17,5	628
Marsh Harrier	<i>Circus aeruginosus</i>	a	14	50	35,7	89
Sand Martin	<i>Riparia riparia</i>	a	10	10	100,0	50
Tree Pipit	<i>Anthus trivialis</i>	a	13	37	100,0	185
Yellow Wagtail	<i>Motacilla cinerea</i>	a	11	17	100,0	85
Blackbird	<i>Turdus merula</i>	e	154	154	65,8	506
Blue Tit	<i>Parus cearulens</i>	e	39	39	100,0	193
Brambling	<i>Fringilla montifringilla</i>	e	11 622	11 661	31,3	18 276
Bullfinch	<i>Pyrrhula pyrrhula</i>	e	4	4	100,0	20
Buzzard	<i>Buteo buteo</i>	e	3	9	0,0	-
Chaffinch	<i>Fringilla coelebs</i>	e	32 399	32 603	42,7	69 620
Cirl Bunting	<i>Emberiza cirius</i>	e	1	1	-	-
Cormorant	<i>Phalacrocorax sinensis</i>	e	186	190	77,8	741
Crane	<i>Grus grus</i>	e	1	2	100,0	12
Crossbill	<i>Loxia curvirostra</i>	e	2	2	50,0	6
Dunnock	<i>Prunella modularis</i>	e	75	78	100,0	390
Fieldfare	<i>Turdus pilaris</i>	e	432	449	55,9	1.255
Goldfinch	<i>Carduelis carduelis</i>	e	38	39	100,0	197
Great White Egret	<i>Ardea alba</i>)	e	10	16	30,0	25
Greenfinch	<i>Chloris chloris</i>	e	10	13	100,0	63
Grey Herron	<i>Ardea cinerea</i>	e	6	6	30,0	10
Hawfinch	<i>Coccothraustes coccothraustes</i>	e	126	127	89,8	570
Jackdaw	<i>Corvus monedula</i>	e	18	18	60,0	54
Kestrel	<i>Falco tinninculus</i>	e	32	32	87,9	139
Linnit	<i>Carduelis cannabina</i>	e	393	393	80,7	1587
Little Egret	<i>Egretta garzetta</i>	e	11	77	0,0	-
Meadow Pipit	<i>Anthus pratensis</i>	e	248	249	99,2	1235
Merlin	<i>Falco columbaris</i>	e	10	10	40,0	21
Mistle Thrush	<i>Turdus viscivorus</i>	e	242	242	65,7	796
Peregrine	<i>Falco peregrinus</i>	e	5	11	0,0	-
Red Kite	<i>Milvus milvus</i>	e	192	192	36,1	346
Redpoll	<i>Carduelis flammea</i>	e	1	1	100,0	5
Redwing	<i>Turdus iliacus</i>	e	1922	2182	44,9	4899
Reed Bunting	<i>Embiriza schoeniclus</i>	e	3	3	100,0	15
Ring Ouzel	<i>Turdus torquatus</i>	e	1	1	100,0	5
Rook	<i>Corvus frugilegus</i>	e	14	14	16,7	12
Siskin	<i>Carduelis spinus</i>	e	884	891	57,9	2580
Skylark	<i>Alauda arvensis</i>	e	392	392	41,5	812
Songthrush	<i>Turdus philomelos</i>	e	1013	1013	56,4	2856
Sparrowhawk	<i>Accipiter nisus</i>	e	11	17	69,2	59
Starling	<i>Sturnus vulgaris</i>	e	951	979	43,1	2111
Stock Dove	<i>Columba oenas</i>	e	51	51	69,4	177
Stonechat	<i>Saxicola rubicola</i>	e	1	-	100,0	-
Tjiftjaf	<i>Phylloscopus collybita</i>	e	3	3	100,0	15
Tree Sparrow	<i>Passer montanus</i>	e	12	12	100,0	60
Water Pipit	<i>Anthus spinoletta</i>	e	1	1	100,0	5
White Wagtail	<i>Motacilla alba</i>	e	82	88	97,5	429
Wood Lark	<i>Lullula arborea</i>	e	52	52	100,0	260
Woodpigeon	<i>Columba palumbus</i>	e	184 337	184 727	12,1	111 978
Yellowhammer	<i>Emberiza citrinella</i>	e	10	12	100,0	58
All birds			237 183	238 438	18,7	222 871

Table 3.2 Number of birds during the whole day; see for explanation table 3.1. Table on next page.

Species		strategy	N	EST day	% with direction	SEST day
Black Stork	<i>Ciconia nigra</i>	a	15	15	60,0	45
Barn Swallow	<i>Hirundo rustica</i>	a	4786	4942	28,8	7125
Black Kite	<i>Milvus migrans</i>	a	2	2	100,0	10
Booted Eagle	<i>Hieraaetus pennatus</i>	a	1	1	100,0	5
Hobby	<i>Falco subbuteo</i>	a	8	14	75,0	53
Honny Buzzard	<i>Pernis apivorus</i>	a	8	38	87,5	166
House Martin	<i>Delchion urbica</i>	a	7804	7960	35,7	14 227
Marsh Harrier	<i>Circus aeruginosus</i>	a	34	94	40,0	188
Osprey	<i>Pandion haliaetus</i>	a	3	15	100,0	75
Red-footed Falcon	<i>Falco vespertinus</i>	a	1	1	100,0	5
Sand Martin	<i>Riparia riparia</i>	a	370	370	75,7	1400
Swift	<i>Apus apus</i>	a	1	1	-	-
Tree Pipit	<i>Anthus trivialis</i>	a	28	76	100,0	380
Yellow Wagtail	<i>Motacilla flava</i>	a	2	2	100,0	10
Blackbird	<i>Turdus merula</i>	e	196	196	63,3	620
Black-headed Gull	<i>Larus ridibundus</i>	e	9	9	100,0	45
Blue Tit	<i>Parus cearulens</i>	e	59	59	100,0	295
Brambling	<i>Fringilla montifringilla</i>	e	22 452	22 492	29,8	33 497
Bullfinch	<i>Pyrrhula pyrrhula</i>	e	4	4	100,0	20
Buzzard	<i>Buteo buteo</i>	e	115	115	39,7	228
Chaffinch	<i>Fringilla coelebs</i>	e	54 218	54 450	42,3	115 252
Cirl Bunting	<i>Emberiza cirius</i>	e	1	1	100,0	5
Cormorant	<i>Phalacrocorax sinensis</i>	e	502	536	56,6	1518
Corn Bunting	<i>Emberiza calandra</i>	e	2	2	100,0	10
Crane	<i>Grus grus</i>	e	3537	4530	11,9	2705
Crossbill	<i>Loxia curvirostra</i>	e	10	10	90,0	45
Dunnock	<i>Prunella modularis</i>	e	85	88	100,0	438
Fieldfare	<i>Turdus pilaris</i>	e	642	669	54,5	1822
Goldfinch	<i>Carduelis carduelis</i>	e	117	118	100,0	592
Great White Egret	<i>Ardea alba</i>	e	11	17	36,4	31
Green Sandpiper	<i>Tringa ochropus</i>	e	3	3	100,0	15
Greenfinch	<i>Chloris chloris</i>	e	19	24	100,0	122
Grey Herron	<i>Ardea cinerea</i>	e	9	9	38,5	17
Grey Wagtail	<i>Motacilla cinerea</i>	e	15	21	100,0	105
Hawfinch	<i>Coccothraustes coccothraustes</i>	e	202	203	93,0	946
Hen Harrier	<i>Circus cyaneus</i>	e	3	3	66,7	10
Jackdaw	<i>Corvus monedula</i>	e	51	51	72,5	185
Kestrel	<i>Falco tinninulus</i>	e	196	196	62,4	612
Linnit	<i>Carduelis cannabina</i>	e	850	850	79,3	3371
Little Egret	<i>Egretta garzetta</i>	e	11	77	-	-
Meadow Pipit	<i>Anthus pratensis</i>	e	601	602	98,0	2952
Merlin	<i>Falco columbaris</i>	e	30	30	46,7	70
Mistle Thrush	<i>Turdus viscivorus</i>	e	501	501	47,7	1194
Peregrine	<i>Falco peregrinus</i>	e	7	13	9,1	6
Raven	<i>Corvus corax</i>	e	1	1	-	-
Red Kite	<i>Milvus milvus</i>	e	2021	2074	35,0	3625
Redpoll	<i>Carduelis flammea</i>	e	2	2	100,0	10
Redwing	<i>Turdus iliacus</i>	e	2504	2780	41,4	5750
Reed Bunting	<i>Emberiza schoeniclus</i>	e	4	4	100,0	20
Ring Ouzel	<i>Turdus torquatus</i>	e	5	5	100,0	25
Rook	<i>Corvus frugilegus</i>	e	55	59	60,0	177
Siskin	<i>Carduelis spinus</i>	e	1861	1869	62,5	5837
Skylark	<i>Alauda arvensis</i>	e	3039	3062	47,0	7202
Songthrush	<i>Turdus philomelos</i>	e	1343	1343	57,3	3847
Sparrowhawk	<i>Accipiter nisus</i>	e	97	97	48,0	233
Starling	<i>Sturnus vulgaris</i>	e	1369	1397	42,9	2998
Stock Dove	<i>Columba oenas</i>	e	158	158	67,1	530
Stonechat	<i>Saxicola rubicola</i>	e	1	1	100,0	5
Tjiftjaf	<i>Phylloscopus collybita</i>	e	3	3	100,0	15
Tree Sparrow	<i>Passer montanus</i>	e	12	12	100,0	60
Water Pipit	<i>Anthus spinoletta</i>	e	2	2	100,0	10
White Wagtail	<i>Motacilla alba</i>	e	115	121	98,2	594
Wood Lark	<i>Lullula arborea</i>	e	222	222	98,2	1090
Woodpigeon	<i>Columba palumbus</i>	e	337 183	337 578	11,0	184 840
Yellowhammer	<i>Emberiza citrinella</i>	e	17	18	100,0	92
All birds			447 534	450 312	18,0	405 281

Table 3.3 *Total number of birds in the early morning and during the whole day, maximum number seen on a single early morning or whole day and the maximum number relative to the total number. Scarce species omitted and species ranked on alphabeth.*

		N em	max	% N	N day	max	% N
Black Stork	Ciconia nigra		0		15	4	26,7
Barn Swallow	Hirundo rustica	416	147	35,3	4786	1432	29,9
Blackbird	Turdus merula	154	30	19,5	196	31	15,8
Blue Tit	Parus cearulens	39	8	20,7	59	13	22,0
Brambling	Fringilla montifringilla	11 622	1962	16,9	22 452	3392	15,1
Buzzard	Buteo buteo	3	1		115	13	11,3
Chaffinch	Fringilla coelebs	32 399	3358	10,4	54 218	5521	10,2
Cormorant	Phalacrocorax sinensis	186	36	19,3	502	66	13,1
Crane	Grus grus	1	1		3537	1810	51,2
Dunnock	Prunella modularis	75	6	8,0	85	7	8,2
Fieldfare	Turdus pilaris	432	80	18,5	642	94	14,6
Goldfinch	Carduelis carduelis	38	8	21,1	117	19	16,2
Great White Egret	Ardea alba	10	3	30,0	11	3	27,3
Greenfinch	Chloris chloris	10	4	40,0	19	4	21,1
Grey Herron	Ardea cinerea	6	2	33,3	9	2	22,2
Grey Wagtail	Motacilla cinerea	11	2	18,2	15	3	20,0
Hawfinch	Coccothraustes coccothraustes	126	15	11,9	202	20	9,9
Hobby	Falco subbuteo	1	1		8	2	25,0
Honny Buzzard	Pernis apivorus	4	2		8	5	62,5
House Martin	Delchion urbica	716	484	67,6	7804	2526	32,4
Jackdaw	Corvus monedula	18	10	55,6	51	19	37,3
Kestrel	Falco tinninculus	32	8	25,3	196	26	13,3
Linnit	Carduelis cannabina	393	50	12,7	850	133	15,6
Marsh Harrier	Circus aeruginosus	14	6	42,9	34	11	32,4
Meadow Pipit	Anthus pratensis	248	48	19,4	601	82	13,6
Merlin	Falco columbaris	10	1	10,0	30	4	13,3
Mistle Thrush	Turdus viscivorus	242	51	21,0	501	109	21,8
Peregrine	Falco peregrinus	5	2	40,0	7	2	28,6
Red Kite	Milvus milvus	192	61	31,8	2021	232	11,5
Redwing	Turdus iliacus	1922	229	11,9	2504	292	11,7
Rook	Corvus frugilegus	14	9	64,3	55	19	34,5
Siskin	Carduelis spinus	884	99	11,2	1861	187	10,0
Skylark	Alauda arvensis	392	102	26,0	3039	533	17,5
Songthrush	Turdus philomelos	1013	133	13,1	1343	295	22,0
Sparrowhawk	Accipiter nisus	11	2	18,2	97	8	8,2
Starling	Sturnus vulgaris	951	135	14,2	1369	171	12,5
Stock Dove	Columba oenas	51	10	19,6	158	13	8,2
Tree Pipit	Anthus trivialis	13	4	30,8	28	8	28,6
White Wagtail	Motacilla alba	82	8	9,8	115	10	8,7
Wood Lark	Lullula arborea	52	10	19,2	222	65	29,3
Woodpigeon	Columba palumbus	184 337	41.334	22,4	337 183	76 902	22,8
Yellowhammer	Emberiza citrinella	10	2	20,0	17	3	17,6
All birds		237 183	42.947	18,1	447 534	81 252	18,2

The maximum number seen on a single early morning relative to the total number of birds ranged from less than 10% for Dunnock and White Wagtail till more than 60% for House Martin and Rook (table 3.3). The median value was 19,6%. During the whole day less than 10% was calculated for Hawfinch, Dunnock and White Wagtail and more than 30% for Jackdaw, Rook, Honey Buzzard and Crane. The median value was 16,2%. For all birds together the maximum was 18% of the total for the early morning as well as the whole day. If we compare the calculated values for the early morning and the whole day, the maximum during a whole was relative small compared to the early morning (figure 3.c).

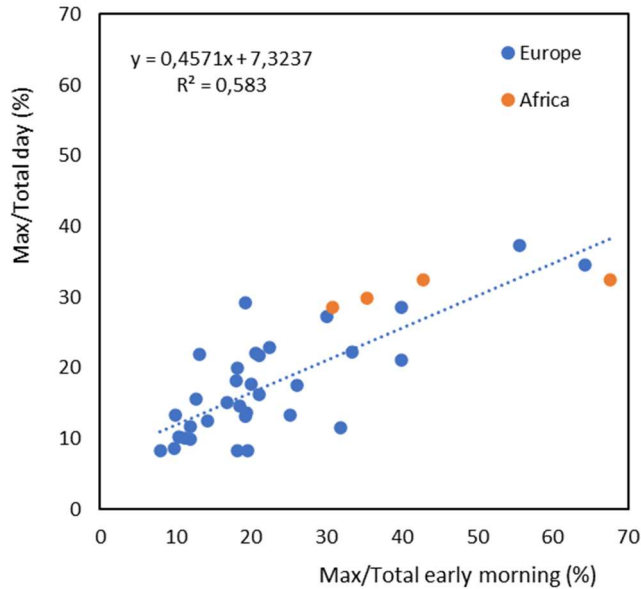


Figure 3.3 Relation between the maximum (as a proportion of the seasonal total) in the early morning and the whole day.

3.3 Timing of migration

The counts in autumn 2022 were focused on the passage of the short distance migrants. Most of these species start their migration somewhere in September and end the migration somewhere in November (table 3.4). After the start of the counts half September the end of the migration of long distance migration was registered and the first of short distance migrants. Long distance migrants start their journey somewhere in August (some in July) and have their maximum at the end of August or the beginning of September. Short distance migrants had their maximum somewhere in October. In this month also the last long distance migrants were seen. In November the numbers of most short distance migrants lowered strong, some stayed relative numerous.

The timing of migration is expressed in the dates with the percentiles for 10, 50 and 90% of the seasonal total (table 3.4). The short distance migrants reached the D10 between week 38 and 43 with the most in week 40 (1-7 Oct). Great white egret, Buzzard and Sparrowhawk were the first among all species and Fieldfare the last one. Species reached the D50 between week 39 and week 44, with the most in week 42 (15-21 Oct). The first species to reach the D50 was Black-headed Gull and the last ones Redwing, Starling, Fieldfare, Reed Bunting and Greenfinch. The D90 was reached in week 42 till week 46 with the most in week 44 (29 Oct – 4 Nov). The first species to reach the D90 was Grey Wagtail and the last ones Great White egret and Greenfinch.

The length of the Full migration period ranged from less than 26 days for Rook, Ring Ouzel and Fieldfare up to more than 55 days for Great White Egret, Cormorant, Wood Pigeon, Red Kite and Chaffinch (table 3.4). The median value was located for the class 41-45 days. The Main migration period ranged from 9 days (Woodpigeon) to 45 days (Buzzard) and 58 days (Great White Egret). The median value was located in the class 21-25 days. The Top migration period had a length between 6 days (Woodlark) and more than 25 days (Greenfinch, Yellowhammer and Grey Herron). The median value was located in the class 11-15 days.

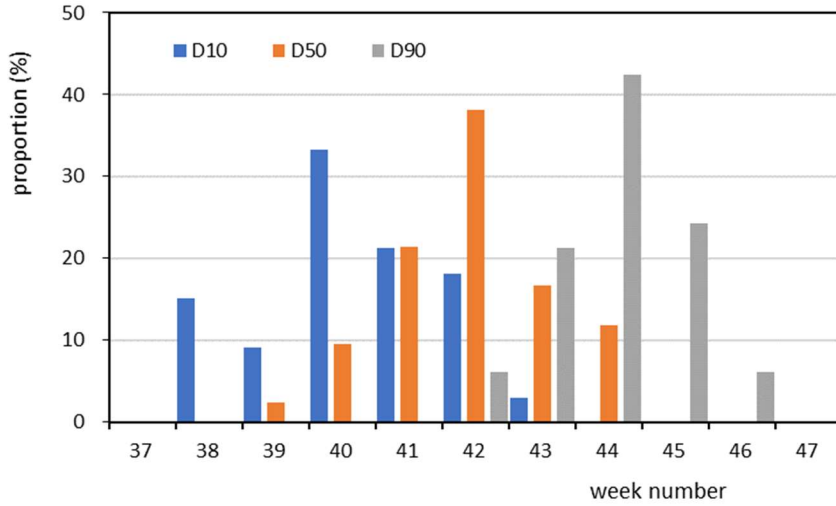


Figure 3.4 Distribution of the onset (D10), median (D50) and offset (D90) of the timing of short distance migrants over standard weeks (40 = 1-7 Oct).

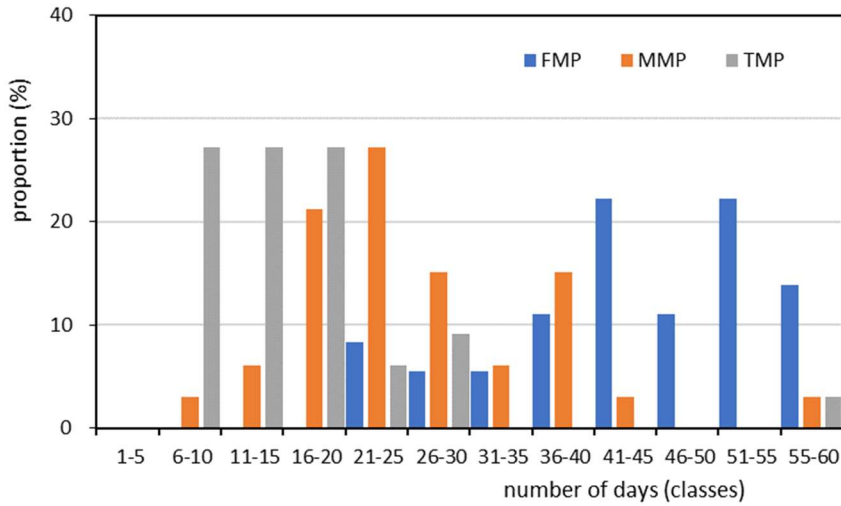


Figure 3.5 Distribution of the length in days of the FMP = Full migration period, the MMP = Main migration period and the TMP Top migration period for short distance migrants.

Table 3.4 Overview of the timing of migration based on counts of the whole day. D0 = first observation, D10 = date 10% of the seasonal total has passed, etc. FMP full migration period in days, MMP = Main migration period in days, TMP Top migration period. Table on net page. a = long distance migrant, e = short distance migrant. Table on next page.

			D0	D10	D25	D50	D75	D90	D100	FMP	MMP	PMP
Honey Buzzard	<i>Pernis apivorus</i>	a							19-sep			
Yellow Wagtail	<i>Motacilla flava</i>	a							24-sep			
Booted Eagle	<i>Hieraaetus pennatus</i>	a							26-sep			
Sand Martin	<i>Riparia riparia</i>	a						23-sep	29-sep			
Hobby	<i>Falco subbuteo</i>	a							7-okt			
Tree Pipit	<i>Anthus trivialis</i>	a							9-okt			
Red-footed Falcon	<i>Falco vespertinus</i>	a							13-okt			
Osprey	<i>Pandion haliaetus</i>	a							13-okt			
Black Kite	<i>Milvus migrans</i>	a							18-okt			
Black Stork	<i>Ciconia nigra</i>	a							19-okt			
Barn Swallow	<i>Hirundo rustica</i>	a						6-okt	25-okt			
Green Sandpiper	<i>Tringa ochropus</i>	a	28-okt			28-okt			28-okt			
House Martin	<i>Delchion urbica</i>	a						6-okt	30-okt			
Marsh Harrier	<i>Circus aeruginosus</i>	a						29-sep	10-nov			
Black-headed Gull	<i>Larus ridibundus</i>	e	26-sep			26-sep			26-sep			
Buzzard	<i>Buteo buteo</i>	e	16-sep	18-sep	22-sep	2-okt	11-okt	2-nov	10-nov	55	45	19
Grey Wagtail	<i>Motacilla cinerea</i>	e	16-sep	23-sep	2-okt	5-okt	13-okt	15-okt	15-okt	29	22	11
Peregrine	<i>Falco peregrinus</i>	e	16-sep			5-okt			7-nov	52		
Sparrowhawk	<i>Accipiter nisus</i>	e	16-sep	17-sep	25-sep	5-okt	16-okt	27-okt	10-nov	55	40	21
Hen Harrier	<i>Circus cyaneus</i>	e	7-okt			8-okt			8-okt			
White Wagtail	<i>Motacilla alba</i>	e	16-sep	28-sep	4-okt	9-okt	21-okt	30-okt	7-nov	52	32	17
Meadow Pipit	<i>Anthus pratensis</i>	e	23-sep	5-okt	8-okt	10-okt	17-okt	26-okt	13-nov	51	21	9
Dunnock	<i>Prunella modularis</i>	e	24-sep	2-okt	4-okt	12-okt	23-okt	6-nov	13-nov	50	35	19
Songthrush	<i>Turdus philomelos</i>	e	18-sep	4-okt	7-okt	12-okt	14-okt	21-okt	10-nov	53	17	7
Blue Tit	<i>Parus cearulens</i>	e	2-okt	2-okt	7-okt	15-okt	27-okt	7-nov	10-nov	39	36	20
Linnit	<i>Carduelis cannabina</i>	e	26-sep	7-okt	8-okt	16-okt	19-okt	24-okt	9-nov	44	17	11
Hawfinch	<i>C. coccothraustes</i>	e	23-sep	5-okt	9-okt	17-okt	23-okt	29-okt	13-nov	51	24	14
Wood Lark	<i>Lullula arborea</i>	e	30-sep	9-okt	13-okt	17-okt	19-okt	28-okt	11-nov	42	19	6
Yellowhammer	<i>Emberiza citrinella</i>	e	9-okt	12-okt	13-okt	17-okt	10-nov	11-nov	11-nov	33	30	28
Stock Dove	<i>Columba oenas</i>	e	18-sep	3-okt	8-okt	17-okt	24-okt	27-okt	6-nov	49	24	16
Red Kite	<i>Milvus milvus</i>	e	16-sep	7-okt	8-okt	17-okt	28-okt	6-nov	14-nov	59	30	20
Chaffinch	<i>Fringilla coelebs</i>	e	17-sep	7-okt	10-okt	17-okt	24-okt	31-okt	14-nov	58	24	14
Kestrel	<i>Falco tinninulus</i>	e	22-sep	1-okt	8-okt	18-okt	25-okt	31-okt	10-nov	49	30	17
Ring Ouzel	<i>Turdus torquatus</i>	e	6-okt			19-okt			29-okt	23		
Mistle Thrush	<i>Turdus viscivorus</i>	e	22-sep	9-okt	13-okt	19-okt	20-okt	29-okt	11-nov	50	20	7
Woodpigeon	<i>Columba palumbus</i>	e	16-sep	17-okt	18-okt	19-okt	25-okt	26-okt	14-nov	59	9	7
Jackdaw	<i>Corvus monedula</i>	e	3-okt	5-okt	18-okt	19-okt	25-okt	30-okt	6-nov	34	25	7
Merlin	<i>Falco columbaris</i>	e	18-sep	29-sep	8-okt	19-okt	24-okt	27-okt	31-okt	43	28	16
Blackbird	<i>Turdus merula</i>	e	20-sep	10-okt	13-okt	20-okt	28-okt	1-nov	11-nov	52	22	15
Siskin	<i>Carduelis spinus</i>	e	3-okt	13-okt	16-okt	21-okt	27-okt	2-nov	14-nov	42	20	11
Cormorant	<i>Phalacrocorax sinensis</i>	e	16-sep	23-sep	7-okt	22-okt	29-okt	1-nov	13-nov	58	39	22
Skylark	<i>Alauda arvensis</i>	e	30-sep	17-okt	19-okt	23-okt	28-okt	31-okt	12-nov	43	14	9
Grey Herron	<i>Ardea cinerea</i>	e	25-sep	25-sep	5-okt	24-okt	1-nov	2-nov	4-nov	40	38	27
Rook	<i>Corvus frugilegus</i>	e	19-okt	19-okt	19-okt	25-okt	2-nov	2-nov	12-nov	24	14	14
Great White Egret	<i>Ardea alba</i>	e	16-sep	17-sep	18-sep	26-okt	14-nov	14-nov	14-nov	59	58	57
Brambling	<i>Fringilla montifringilla</i>	e	30-sep	17-okt	20-okt	26-okt	29-okt	3-nov	14-nov	45	17	9
Goldfinch	<i>Carduelis carduelis</i>	e	6-okt	10-okt	18-okt	27-okt	2-nov	8-nov	12-nov	37	29	15
Redwing	<i>Turdus iliacus</i>	e	1-okt	19-okt	21-okt	29-okt	6-nov	11-nov			23	16
Starling	<i>Sturnus vulgaris</i>	e	3-okt	18-okt	25-okt	29-okt	2-nov	8-nov	14-nov	42	21	8
Fieldfare	<i>Turdus pilaris</i>	e	21-okt	22-okt	27-okt	30-okt	7-nov	11-nov			20	11
Reed Bunting	<i>Emberiza schoeniclus</i>	e	9-okt			31-okt			6-nov			
Greenfinch	<i>Chloris chloris</i>	e	4-okt	6-okt	7-okt	2-nov	6-nov	12-nov	13-nov	40	37	30
Swift	<i>Apus apus</i>	e							25-sep			
Stonechat	<i>Saxicola rubicola</i>	e							26-sep			
Tjiftjaf	<i>Phylloscopus collybita</i>	e							26-sep			
Little Egret	<i>Egretta garzetta</i>	e	16-sep						16-sep			
Tree Sparrow	<i>Passer montanus</i>	e	24-sep						2-okt	8		
Crossbill	<i>Loxia curvirostra</i>	e	2-okt						9-nov			
Raven	<i>Corvus corax</i>	e	7-okt						7-okt			
Cirl Bunting	<i>Emberiza cirlus</i>	e	10-okt						10-okt			
Crane	<i>Grus grus</i>	e	12-okt	18-okt								
Water Pipit	<i>Anthus spinoletta</i>	e	13-okt						10-nov			
Corn Bunting	<i>Emberiza calandra</i>	e	20-okt						21-okt			
Redpoll	<i>Carduelis flammea</i>	e	4-nov						9-nov			
Bullfinch	<i>Pyrrhula pyrrhula</i>	e	7-nov						7-nov			
All birds			16-sep	13-okt	18-okt	19-okt	25-okt	28-okt	14-nov	59	15	7

3.4 Direction of migration

For the short distance migrants the average direction of migration is concentrated around SW, and for the long distance migrants around SSW (figure). Deviations are mainly seen for short distance migrants seen in low numbers. Among the long distance migrants the main migration direction is for most species SSW and for the short distance migrants SW (table). Both numerous swallow had a relative low proportion of all birds in the main migration direction (<50%). Among the short distance migrants high proportions were calculated for Woodpigeon, Brambling, Goldfinch, Starling and Chaffinch; i.c. around 90%; low figures were still above 50%.

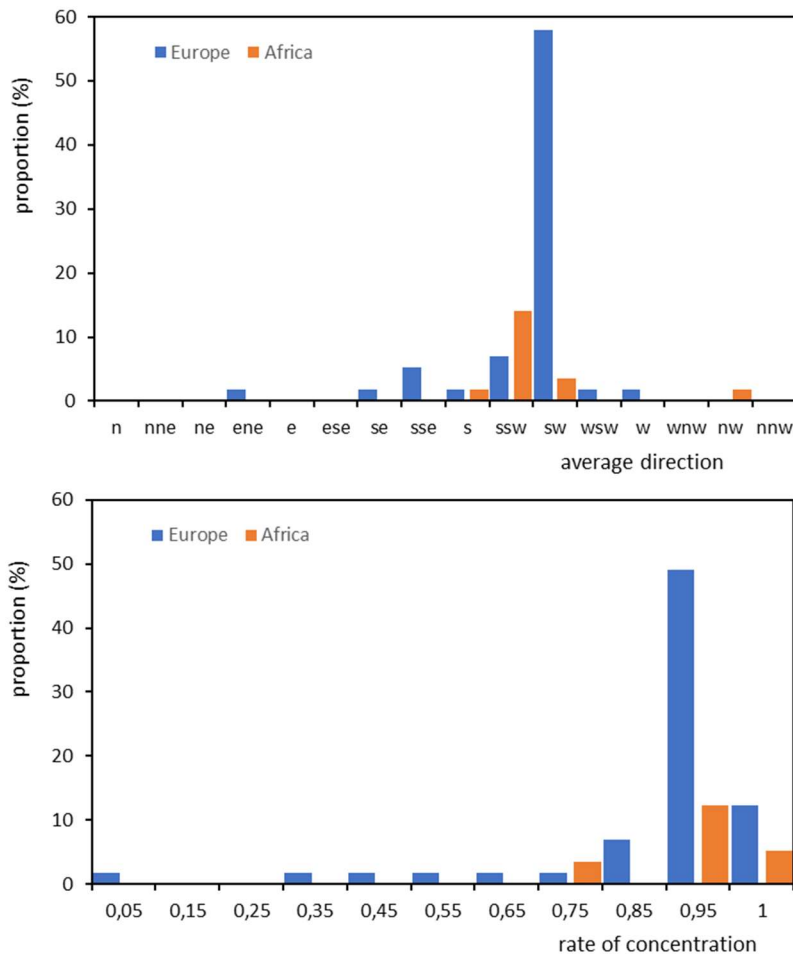


Figure 3.6 Distribution of the average direction of migration over de standard directions for short ($n = 45$) and long distance migrants ($n = 12$), and the distribution over classes in the rate of concentration of the average direction, proportion calculated on both groups together ($n = 57$) data in table 3.x.

For most species the average direction of migration was very concentrated, with values above 0,900. Species with only one or two flocks with a direction show the highest concentration possible; 1,000. The lowest rate was calculated for the Great White Egret; 0,000. Directions do equal each other. Relative low values were seen for House Martin, Barn swallow, Songthrush and Blackbird (<0,800). The first two species may feed during migration, which might lead to migrate in different direction, where the food will bring the birds. On some days Songthrush and Blackbird are seen in all possible directions, especially during the first hours; those birds probably finish their nightly journey and seek for a good place to stay.

Table 3.5 Average direction of migration (A_o) and the rate of concentration around the average (\bar{a}) during the day, Main migration direction (MMD) and the proportion in that direction as well as the number of birds seen within 100 m around the observer and noted with direction (N). Long and short distance migrants separated.

		N	Ao	\bar{a}	MMD	%
House Martin	<i>Delchion urbica</i>	2773	190,4	0,792	ssw	38,2
Barn Swallow	<i>Hirundo rustica</i>	1199	201,3	0,796	ssw	48,4
Sand Martin	<i>Riparia riparia</i>	280	201,7	0,986	ssw	97,9
Booted Eagle	<i>Hieraaetus pennatus</i>	1	202,5	1,000	ssw	100,0
Hobby	<i>Falco subbuteo</i>	6	206,2	0,989	ssw	83,3
Marsh Harrier	<i>Circus aeruginosus</i>	13	209,5	0,972	ssw	53,8
Black Stork	<i>Ciconia nigra</i>	9	209,7	0,917	ssw	44,4
Honny buzzard	<i>Pernis apivorus</i>	7	212,1	0,981	ssw	57,1
Black Kite	<i>Milvus migrans</i>	2	213,7	0,981	ssw/sw	50,0
Tree Pipit	<i>Anthus trivialis</i>	11	221,0	0,989	sw	81,8
Osprey	<i>Pandion haliaetus</i>	3	225,0	1,000	sw	100,0
Green Sandpiper	<i>Tringa ochropus</i>	3	315,0	1,000	nw	100,0
Bullfinch	<i>Pyrrhula pyrrhula</i>	8	67,5	0,383	div	50,0
Great White Egret	<i>Ardea alba</i>	4	135,0	0,000	div	25,0
Black-headed Gull	<i>Larus ridibundus</i>	9	157,5	1,000	sse	100,0
Crossbill	<i>Loxia curvirostra</i>	8	160,4	0,790	se	62,5
Grey Herron	<i>Ardea cinerea</i>	5	162,2	0,404	div	20,0
Cormorant	<i>Phalacrocorax sinensis</i>	277	211,3	0,961	sw	50,2
Hawfinch	<i>Coccothraustes coccothraustes</i>	184	211,9	0,865	sw	54,3
Blackbird	<i>Turdus merula</i>	109	212,2	0,647	sw	51,4
Water Pipit	<i>Anthus spinoletta</i>	2	213,8	0,831	div	50,0
Fieldfare	<i>Turdus pilaris</i>	312	217,2	0,938	sw	53,2
Kestrel	<i>Falco tinninulus</i>	122	217,5	0,968	sw	70,5
Sparrowhawk	<i>Accipiter nisus</i>	46	217,7	0,967	sw	52,2
Buzzard	<i>Buteo buteo</i>	42	218,1	0,969	sw	64,3
Linnit	<i>Carduelis cannabina</i>	635	218,2	0,957	sw	61,7
Blue Tit	<i>Parus cearulens</i>	54	219,3	0,980	sw	77,8
Merlin	<i>Falco columbaris</i>	14	220,4	0,966	sw	71,4
White Wagtail	<i>Motacilla alba</i>	93	221,0	0,979	sw	75,3
Grey Wagtail	<i>Motacilla cinerea</i>	16	221,1	0,951	sw	68,8
Mistle Thrush	<i>Turdus viscivorus</i>	215	221,9	0,868	sw	54,0
Red Kite	<i>Milvus milvus</i>	702	222,0	0,979	sw	76,5
Redwing	<i>Turdus iliacus</i>	794	222,1	0,954	sw	80,1
Skylark	<i>Alauda arvensis</i>	1264	222,1	0,977	sw	87,9
Dunnock	<i>Prunella modularis</i>	46	222,4	0,924	sw	76,1
Stock Dove	<i>Columba oenas</i>	104	223,7	0,986	sw	80,8
Greenfinch	<i>Chloris chloris</i>	19	223,8	0,972	sw	63,2
Goldfinch	<i>Carduelis carduelis</i>	121	224,0	0,992	sw	93,4
Starling	<i>Sturnus vulgaris</i>	464	224,0	0,993	sw	90,5
Chaffinch	<i>Fringilla coelebs</i>	19 273	224,2	0,972	sw	89,3
Ring Ouzel	<i>Turdus torquatus</i>	5	224,2	0,881	sw	60,0
Brambling	<i>Fringilla montifringilla</i>	5674	224,6	0,961	sw	92,2
Meadow Pipit	<i>Anthus pratensis</i>	488	224,7	0,952	sw	82,8
Siskin	<i>Carduelis spinus</i>	976	224,7	0,969	sw	84,1
Rook	<i>Corvus frugilegus</i>	33	225,0	1,000	sw	100,0
Corn Bunting	<i>Emberiza calandra</i>	2	225,0	1,000	sw	100,0
Peregrine	<i>Falco peregrinus</i>	1	225,0	1,000	sw	100,0
Tjiftjaf	<i>Phylloscopus collybita</i>	1	225,0	1,000	sw	100,0
Jackdaw	<i>Corvus monedula</i>	35	225,1	0,905	sw	77,1
Woodpigeon	<i>Columba palumbus</i>	35 140	225,9	0,989	sw	92,3
Songthrush	<i>Turdus philomelos</i>	693	226,6	0,596	sw	50,4
Crane	<i>Grus grus</i>	418	228,7	0,989	sw	83,5
Wood Lark	<i>Lullula arborea</i>	198	230,3	0,958	sw	78,3
Yellowhammer	<i>Emberiza citrinella</i>	17	231,6	0,984	sw	70,6
Hen Harrier	<i>Circus cyaneus</i>	2	236,3	0,981	sw/wsw	50,0
Tree Sparrow	<i>Passer montanus</i>	12	247,5	1,000	wsw	100,0
Redpoll	<i>Carduelis flammea</i>	1	270,0	1,000	w	100,0
All birds		72 945	223,5	0,957	sw	84,4

3.5 Flying height of migrants

During the whole day most birds were seen migrating in height class 6 (37,4%, 100-200m) followed by class 5 (29,2%, 50-100 m) (figure 3.7). Since the woodpigeon was by far the most numerous species, this pattern partly reflects the height distribution of this species (table 3.7). In the early morning a relative large proportion of birds was seen below 100 m height (50,5%). In the late morning the proportion below 100m height lowered till 39,2%. In the early afternoon and late afternoon these values were 25,9% and 18,7%. At the same time the proportion in height class 7 and 8 rose from 7,6% till 67,5%. Note that the highest proportion in class 8 (>500 m) was reached in the early afternoon and the highest in class 7 in the late afternoon. In the early morning the migration is dominated by passerine species whereas in the afternoon migration of passerine species is at a low level or finished. At the same time conditions for soaring birds are optimal in the afternoon. These species are numerous in the afternoon.

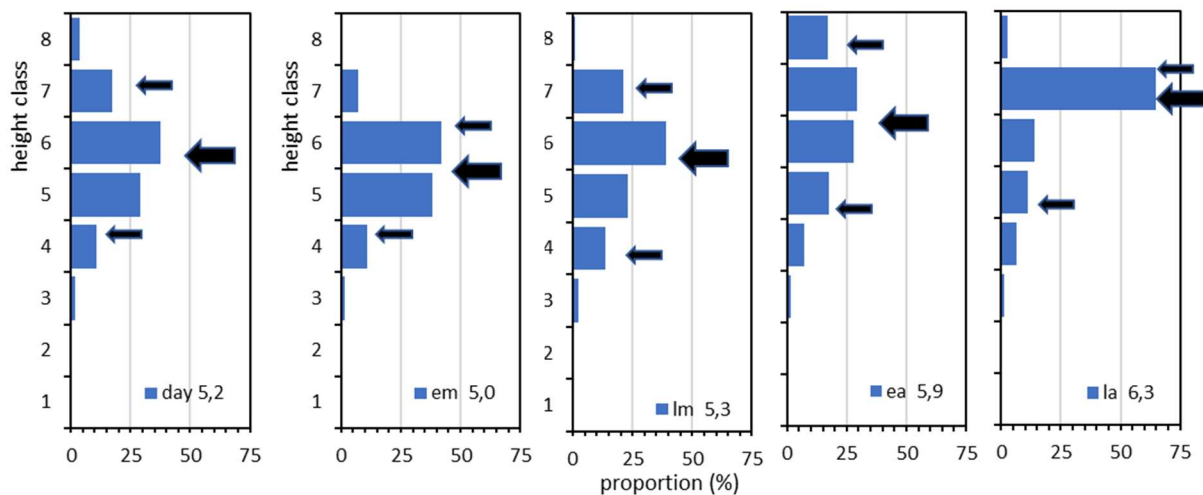


Figure 3.7 Height distribution of migrating birds during the whole day (left), and during the early morning (em), late morning (lm), early afternoon (ea) and late afternoon (la). The median value of the distribution is given at the bottom of the figure.

Table 3.6 The 10%, 50% and 90% percentiles of the height distribution during the whole day, and four parts of the day, as well as the migration intensity during four parts of the day in n/2,5 hours.

			whole day	morning		afternoon	
				early	late	early	late
all birds		10%	3,8	3,8	3,5	4,1	4,2
		50%	5,2	5,0	5,3	5,9	6,3
		90%	6,6	5,9	6,6	7,4	6,9
Red Kite	<i>Milvus milvus</i>	n/2,5 hour		915	490	337	65
		10%	5,2	4,3	5,2	5,8	6,0
		50%	6,8	5,4	6,5	7,1	7,1
Chaffinch	<i>Fringilla coelebs</i>	90%	7,8	6,1	7,7	7,8	7,8
		n/2,5 hour		2,9	10,5	17,8	2,0
		10%	3,2	3,3	3,3	3,0	3,2
		50%	4,2	4,3	4,1	3,9	3,9
		90%	4,7	4,7	4,7	4,5	4,4
	n/2,5 hour		193,6	86,8	33,4	5,0	

To illustrate the shift in species composition during the day the height distribution of Red Kite and Chaffinch are given (figure 3.8, table 3.6). In the early morning migrating Red Kites were most numerous in class 6. In the following parts of the day the most were seen in class 7 and 8. The highest migration intensity was reached in the early afternoon (table 3.6). The Chaffinch had the highest migration intensity in the early morning. In the afternoon intensity was just a fraction of those in the early morning. At the same time, during this period of the day the flew at higher altitudes than later on the day.

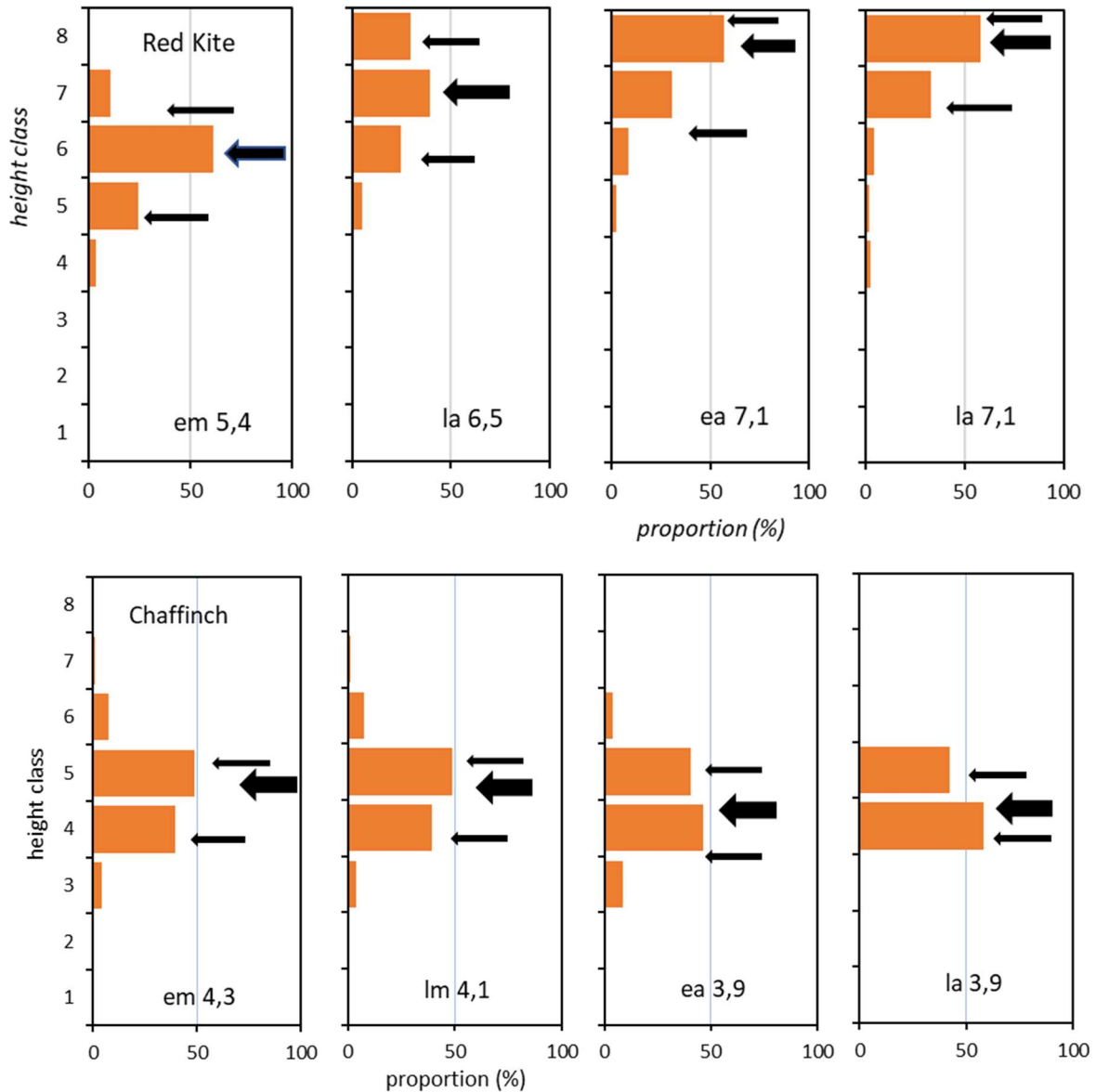


Figure 3.8 Height distribution for Red Kite and Chaffinch for the early morning (em), late morning (lm), early afternoon (ea) and late afternoon (la). The median value of the distribution is given at the bottom of the figure.

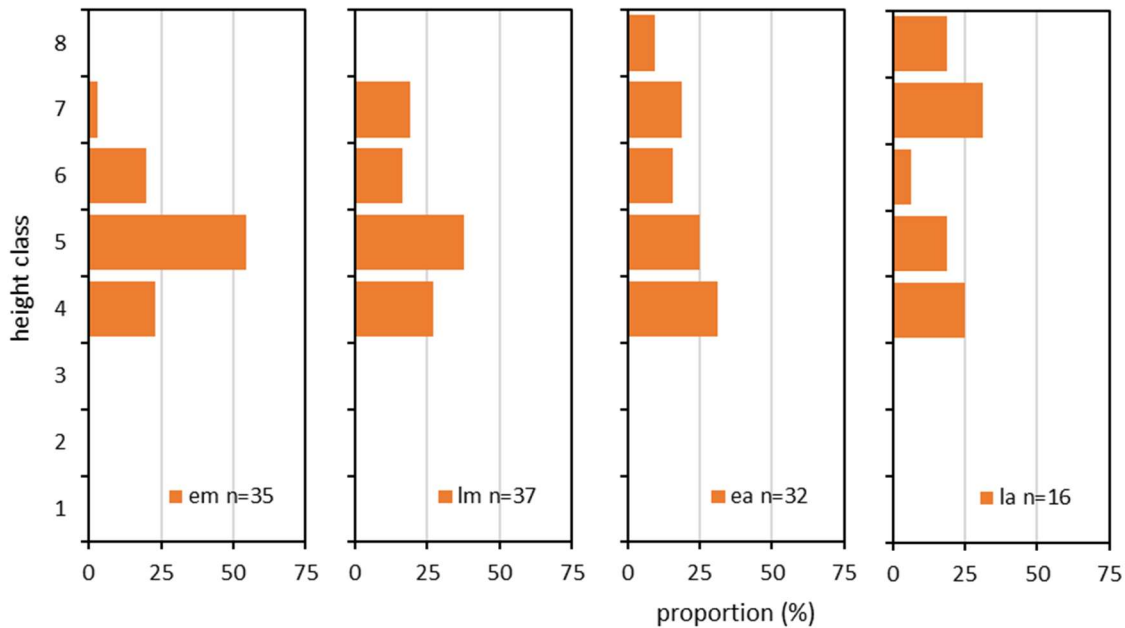


Figure 3.9 Distribution of species over height classes based on the 50% height in the early morning, late morning, early afternoon and late afternoon.

Based on the median height (table 3.7) In the early morning most species seen were flying in height class 4, 5 and 6 (figure 3.9). In the next parts of the day a kind of deviation becomes visible with a group of species in classes 4 and 5 and a group of species in classes 7 and 8. This is linked to passerine species lowering their height during the day and soaring species reaching higher altitudes later on the day.

3.6 Behavioural aspects

Most species migrate in small or large flock. This flocks do have a form+ which tells something about the way a species migrate. Cormorants are most of the time seen in a line or V-formations (figure 3.10). In this formation all birds behind the first bird do save energy (Weimerskirch *et al.* 2001). Among smaller species lines and V-formations are lacking. Instead two major flock formations can be distinguished: a front (birds besides each other) and an elongated form (birds behind each other). Forms like a disc or a ball are in between the two major types. Barn swallows are an example of a species which mainly migrated in elongated formations whereas wood pigeons were mainly seen in frontal formations.

Raptors use three types flight behaviour: flapping, soaring and gliding, with two major combinations: flapping followed by gliding and soaring in a thermal followed by gliding to the next thermal. Here I give the example of the flight behaviour of the Red Kites during the day (figure 3.11). In the early morning a part of the birds used flapping followed by gliding. Later in the early morning birds started soaring. In the afternoon the majority was seen soaring followed by gliding. Sometimes birds make such long glides at great heights that I didn't saw them soaring in the NE, nor in the SW.

Table 3.7 Summary of the height distribution of migrants based on the median flying height (50%) in the early morning, late morning, early afternoon and late afternoon. Species in alphabetic order.

		morning		afternoon	
		early	late	early	late
Barn Swallow	<i>Hirundo rustica</i>	5,1	4,1	6,4	6,3
Black Stork	<i>Ciconia nigra</i>		6,9	6,5	6,6
Blackbird	<i>Turdus merula</i>	3,8	3,6		
Blue Tit	<i>Parus cearulens</i>	3,2	3,2	3,4	
Brambling	<i>Fringilla montifringilla</i>	4,3	4,2	4,4	3,5
Buzzard	<i>Buteo buteo</i>	5,3	6,6	7,3	7,3
Chaffinch	<i>Fringilla coelebs</i>	4,3	4,1	3,9	3,9
Cormorant	<i>Phalacrocorax sinensis</i>	6,2	6,5	6,4	-
Crane	<i>Grus grus</i>			7,1	7,5
Dunnoek	<i>Prunella modularis</i>	4,4	4,3	3,5	
Fieldfare	<i>Turdus pilaris</i>	4,3	3,5	4,5	
Goldfinch	<i>Carduelis carduelis</i>	3,7	3,6	3,3	
Greenfinch	<i>Chloris chloris</i>	4,5	3,6		
Grey Wagtail	<i>Motacilla cinerea</i>	4,9	4,8		
Hawfinch	<i>Coccothraustes coccothraustes</i>	4,5	4,7	4,5	4,5
Hobby	<i>Falco subbuteo</i>	3,5	5,5	5,5	
House Martin	<i>Delchion urbica</i>	5,5	6,3	6,4	6,4
Jackdaw	<i>Corvus monedula</i>		5,3		
Kestrel	<i>Falco tinninculus</i>	4,8	5,4	5,9	6,7
Linnit	<i>Carduelis cannabina</i>	3,7	3,5	3,2	
Marsh Harrier	<i>Circus aeruginosus</i>	5,5	6,1	6,5	
Meadow Pipit	<i>Anthus pratensis</i>	4,4	4,4	4,3	3,5
Merlin	<i>Falco columbaris</i>	4,5	4,7	4,5	
Mistle Thrush	<i>Turdus viscivorus</i>	4,3	4,4	3,6	
Peregrine	<i>Falco peregrinus</i>				
Red Kite	<i>Milvus milvus</i>	5,4	6,5	7,1	7,1
Redwing	<i>Turdus iliacus</i>	3,8	3,7	4,0	4,0
Rook	<i>Corvus frugilegus</i>	4,6	6,0	5,5	
Sand Martin	<i>Riparia riparia</i>			3,6	
Siskin	<i>Carduelis spinus</i>	3,7	3,5	3,4	3,5
Skylark	<i>Alauda arvensis</i>	4,9	4,9	4,6	
Songthrush	<i>Turdus philomelos</i>	4,2	4,3	3,9	
Sparrowhawk	<i>Accipiter nisus</i>	5,1	5,8	6,4	6,5
Starling	<i>Sturnus vulgaris</i>	3,4	4,2		
Stock Dove	<i>Columba oenas</i>	4,7	5,4	5,5	4,5
Tjiftjaf	<i>Phylloscopus collybita</i>				
Tree Pipit	<i>Anthus trivialis</i>	4,8	4,0	3,5	
White Wagtail	<i>Motacilla alba</i>	4,4	3,8		
Wood Lark	<i>Lullula arborea</i>	4,5	4,5	4,3	
Woodpigeon	<i>Columba palumbus</i>	5,4	5,6	5,4	5,0
Yellowhammer	<i>Emberiza citrinella</i>	4,2	3,8		
All birds		5,0	5,3	5,9	6,3

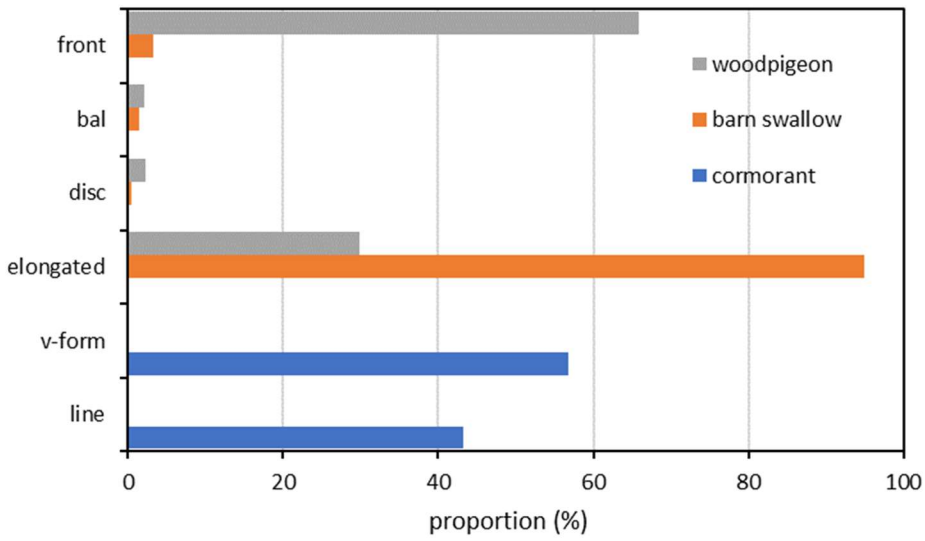


Figure 3.10 Flock formations for three species as a proportion of the total number of birds; Cormorant n = 419, Barn Swallow n = 2759, Woodpigeon n = 48 043.

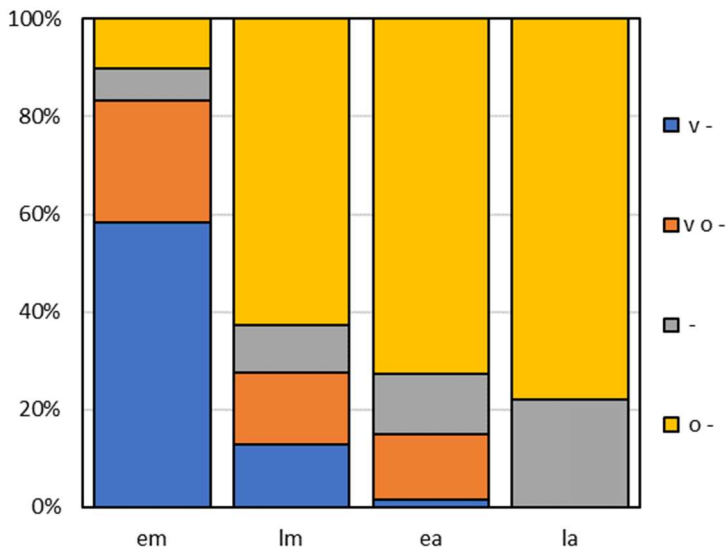


Figure 3.11 Flight behaviour of migrating Red Kites during the early morning (n = 168), late morning (n = 611), early afternoon (n = 1050) and late afternoon (n = 105). v = flapping, - = gliding o = soaring.

4 Discussion

Methods

The method I used has been proved to be useful. The main points are a circle of 100 m around the observer to limit the amount of work to be done and to maintain accuracy in data sampling. Within the circle one can be more precise in estimating number, direction, height and other aspects.

At greater distance it was difficult to distinguish between brambling and chaffinch. Flocks of bramblings seems to be more dynamic. After discussion with other observers, I think I overestimated the number of Bramblings. Therefore the number of Chaffinches might have been higher and the calculated median date 1 or 2 days later.

Number of birds

Since I started counting on the 16th of September most of the long distance migrants already have passed. Therefore the number seen of these species in the last days of September, is no more of a glimpse of the real number. To sort that out is for another year. To see the start of the short distance migrants this data was just early enough. The last count was done at 14th November. In the days before intensity had lowered day after day indicating migration had come to an end. For some species later in November some small waves of migrants could be expected. So, the number seen is a minimum but for most species it would not have been really changed if I would counted till the end of November.

Timing of migration

For the short distance migrants the seasonal pattern was characterized by the 10%, 25%, 50%, 75% and 90% percentiles. These figures are valid for autumn 2022. Since the timing can change from year to year with at least a few days. The calculated dates are an indication for a more general picture.

The last count was done at 14th November. For species like Redwing, Fieldfare and Crane more birds could be expected in the second half of November. For such species the calculated length of the Total migration period and most likely the Main migration period are a minimum.

Direction of migration

Migration over the Creuse was concentrated around SW with for short distance species and SSW for long distance migrants. This suggests that the short distance migrants passing the Creuse mainly use the westside of the Pyrenees to enter the Iberian Peninsula. Long distance migrants, moving for Africa were more heading towards Gibraltar, and most probably will cross the Pyrenees in the middle.

Altitude of migration

In the field an estimate was done on the flying height of passing migrants. In the lower air layers, e.g. till 50 m the can be done quite accurate. Surrounding trees, with a known height, can be of help in estimating the height. At higher altitudes references are lacking and It will be the experience of the observer that makes the picture. With more observers present it might help to discuss the estimate and to correct each other if necessary. I did not had any co-observers. Non the less, the general patterns shown will be close to reality.

Species like finches are small. With the naked eye they are visible at a distance of 100/200 m in the horizontal way and 50/100 m in the vertical way. Radar studies have shown that small birds can

migrate up to 1.000 m height during the daylight period, especially with tail winds. With opposite winds birds migrate mainly in the lower air layers; and most of the migrants can be seen by observers on the ground (Buurma *et al.* 1986). In autumn 2022 there was a long period with opposite winds. So in autumn 2022 a substantial part of the total migration was seen.

Conclusion

Counting visible bird migration is a fascinating sport and can help to understand the strategy of species to overcome the distance between breeding and wintering area *vice versa*.

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Appendix 1 Example of notation in the field, 19 October 2022.

Site ID	Date	Observer	Time	Species	Count	Notes	Other
1 7423	19-10-2022	N R M	08:15	Vj	7		
				Vj	1, 2, 1, 1, 1, 1, 2, 1, 2, 2		
Hemo				K	4		
1 x 2L				K	5		
Sjn				Sjn	6		
K				K	2		
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