Flanders
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Trends in winter migration of birds in Northern France

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TRENDS IN WINTER MIGRATION OF BIRDS IN NORTHERN FRANCE

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Contents

1 INTRODUCTION

Naturaconsta provided the raw observations of the winter migration bird counts in France. 31 sites where visted repeatedly resulting in 1206. The observer notes the species, the number of birds and the hour after sunset. Chapter 2 describes the data and the further data preparation in detail. The statistical analysis is described in chapter 3. The last chapter gives the results for each species.

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2 DATA SELECTION

This chapter describes the rules which are used to select the relevant observations to calculate the trends. This can result in data deficient species and sites. Note that this is the evaluation for the current data set. This might change when more data is collected in the future. Hence we highly recommend to keep monitoring all species and all sites.

In order to get a numerically stable model, we need at least 100 occurrences for each species. One occurrence is the observation of at least one individual of a species at a given site, on a given day. The table below lists the number of occurrences per species. Species in bold have at least 100 occurrences. The other species will be ignored in the analysis.

Table 2.1: Total number of occurrences per species.

species	occurrences
Acanthis cabaret	1
Acanthis flammea	6
Accipiter gentilis	9
Accipiter nisus	139
Aegithalos caudatus	51
Alauda arvensis	251
Alca torda	20
Alcedo atthis	1
Alopochen aegyptiaca	6
Anas acuta	24
Anas crecca	17
Anas penelope	31
Anas platyrhynchos	33
Anas strepera	5
Anser anser	34
Anthus pratensis	240
Anthus spinoletta	7
Anthus trivialis	100
Apus apus	2
Aquila chrysaetos	1
Ardea alba	52
Ardea cinerea	63
Aythya ferina	2
Aythya fuligula	2
Bombycilla garrulus	1
Branta bernicla	41
Branta canadensis	3
Branta leucopsis	1
Burhinus oedicnemus	1
Buteo buteo	112
Calcarius lapponicus	2
Calidris alba	24

species	occurrences
Calidris alpina	26
Calidris canutus	3
Calidris pugnax	1
Carduelis carduelis	221
Charadrius dubius	1
Charadrius hiaticula	8
Chloris chloris	212
Circaetus gallicus	1
Circus aeruginosus	36
Circus cyaneus	64
Circus macrourus	1
Circus pygargus	2
Coccothraustes coccothraustes	109
Columba livia	7
Columba oenas	168
Columba palumbus	262
Corvus corax	4
Corvus corone	180
Corvus frugilegus	132
Corvus monedula	118
Cyanistes caeruleus	163
Cygnus olor	7
Delichon urbicum	44
Dendrocopos major	34
Dendropicos medius	1
Dryobates minor	1
Dryocopus martius	7
Egretta garzetta	41
Emberiza calandra	39
Emberiza cirlus	3
Emberiza citrinella	222
Emberiza schoeniclus	101
Erithacus rubecula	36
Falco columbarius	25
Falco peregrinus	20
Falco subbuteo	12
Falco tinnunculus	159
Fringilla coelebs	273
Fringilla montifringilla	146
Gallinago gallinago	91
Gallinula chloropus	1
Garrulus glandarius	155
Gavia arctica	6
Gavia stellata	21
Grus grus	20
Gyps fulvus	1
Haematopus ostralegus	19
Hirundo rustica	101
Hydrocoloeus minutus	15
Larus argentatus	93

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species	occurrences
Larus canus	49
Larus fuscus	62
Larus marinus	37
Larus melanocephalus	4
Larus michahellis	6
Larus ridibundus	68
Limosa lapponica	1
Linaria cannabina	239
Lophophanes cristatus	1
Loxia curvirostra	18
Lullula arborea	156
Luscinia svecica	1
Lymnocryptes minimus	1
Melanitta fusca	1
Melanitta nigra	43
Mergus serrator	3
Milvus migrans	13
Milvus milvus	108
Morus bassanus	36
Motacilla alba	225
Motacilla cinerea	91
Motacilla flava	46
Numenius arquata	25
Numenius phaeopus	1
Oenanthe oenanthe	7
Pandion haliaetus	3
Parus major	136
Passer domesticus	11
Passer montanus	30
Perdix perdix	5
Periparus ater	18
Pernis apivorus	4
Phalacrocorax aristotelis	3
Phalacrocorax carbo	172
Phalaropus fulicaria	1
Phasianus colchicus	2
Phoenicurus ochruros	24
Phoenicurus phoenicurus	1
Phylloscopus collybita	27
Pica pica	24
Picus viridis	41
Platalea leucorodia	3
Plectrophenax nivalis	1
Pluvialis apricaria	104
Pluvialis squatarola	18
Podiceps cristatus	27
Poecile montanus	1
Poecile palustris	3
Prunella modularis	65
Ptyonoprogne rupestris	8

species	occurrences
Puffinus griseus	1
Puffinus mauretanicus	2
Puffinus puffinus	1
Pyrrhula pyrrhula	62
Recurvirostra avosetta	3
Regulus ignicapilla	1
Regulus regulus	11
Riparia riparia	11
Rissa tridactyla	6
Saxicola rubetra	2
Saxicola rubicola	12
Scolopax rusticola	5
Serinus serinus	101
Sitta europaea	7
Somateria mollissima	6
Spatula clypeata	13
Spinus spinus	170
Stercorarius parasiticus	9
Stercorarius pomarinus	1
Stercorarius skua	8
Sterna hirundo	7
Streptopelia decaocto	28
Streptopelia turtur	1
Sturnus vulgaris	273
Sylvia atricapilla	6
Sylvia communis	1
Tadorna ferruginea	1
Tadorna tadorna	28
Thalasseus sandvicensis	11
Tringa nebularia	1
Tringa totanus	2
Troglodytes troglodytes	14
Turdus iliacus	166
Turdus merula	207
Turdus philomelos	247
Turdus pilaris	152
Turdus torquatus	3
Turdus viscivorus	214
Uria aalge	4
Vanellus vanellus	147

We will estimate the seasonal pattern in the migration. Because the migration can be different among the years, we need to estimate a different seasonal pattern for each year. We require at least 10 occurrences per year to estimate the seasonal pattern of a species. The table below gives the number of occurrences per species and per year. Years in which a species has less than 10 occurrences will be removed from the analysis.

species	2012	2013	2014	2015	2016	2017
Accipiter nisus	**31**	**24**	**17**	**20**	**19**	**28**

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species	2012	2013	2014	2015	2016	2017
Alauda arvensis	**45**	**37**	**43**	**41**	**42**	**43**
Anthus pratensis	**42**	**40**	**39**	**39**	**41**	**39**
Anthus trivialis	1	**18**	**22**	**15**	**19**	**25**
Buteo buteo	**16**	**18**	**12**	**12**	**25**	**29**
Carduelis carduelis	**41**	**38**	**34**	**37**	**35**	**36**
Chloris chloris	**36**	**36**	**38**	**37**	**26**	**39**
Coccothraustes coccothraustes	**20**	**11**	**15**	**20**	5	**38**
Columba oenas	**20**	**30**	**24**	**29**	**34**	**31**
Columba palumbus	**46**	**44**	**39**	**44**	**49**	**40**
Corvus corone	**28**	**23**	**34**	**36**	**24**	**35**
Corvus frugilegus	**22**	**22**	**20**	**33**	**17**	**18**
Corvus monedula	**17**	**15**	**22**	**24**	**18**	**22**
Cyanistes caeruleus	**31**	**22**	**28**	**28**	**17**	**37**
Emberiza citrinella	**34**	**35**	**40**	**42**	**36**	**35**
Emberiza schoeniclus	**24**	**16**	**19**	**14**	8	**20**
Falco tinnunculus	**15**	**19**	**30**	**23**	**33**	**39**
Fringilla coelebs	**47**	**43**	**44**	**45**	**48**	**46**
Fringilla montifringilla	**30**	**23**	**20**	**27**	**16**	**30**
Garrulus glandarius	**26**	**30**	9	**24**	**33**	**33**
Hirundo rustica	**13**	**16**	**18**	**17**	**16**	**21**
Linaria cannabina	**38**	**40**	**35**	**43**	**45**	**38**
Lullula arborea	**23**	**20**	**29**	**28**	**24**	**32**
Milvus milvus	**12**	**20**	**12**	**11**	**24**	**29**
Motacilla alba	**30**	**39**	**39**	**42**	**35**	**40**
Parus major	**23**	**13**	**25**	**32**	**14**	**29**
Phalacrocorax carbo	**27**	**30**	**31**	**26**	**30**	**28**
Pluvialis apricaria	**14**	**15**	**19**	**23**	**16**	**17**
Serinus serinus	**17**	**11**	**16**	**12**	**17**	**28**
Spinus spinus	**32**	**23**	**27**	**35**	**23**	**30**
Sturnus vulgaris	**46**	**44**	**46**	**47**	**48**	**42**
Turdus iliacus	**33**	**26**	**22**	**29**	**30**	**26**
Turdus merula	**31**	**27**	**38**	**39**	**37**	**35**
Turdus philomelos	**39**	**38**	**44**	**43**	**40**	**43**
Turdus pilaris	**33**	**21**	**15**	**30**	**28**	**25**
Turdus viscivorus	**30**	**33**	**42**	**38**	**34**	**37**
Vanellus vanellus	**27**	**25**	**24**	**26**	**23**	**22**

Each species migrates during a specific period. Observations outside the migration period are mostly structural zero's and they compromise the stability of the statistical model. Furthermore estimating the number of migrating birds outside of the migration period is not very relevant. Therefore we must determine the relevant migration period. We assume that the migration period depends both on the species and on the year. Fig. 2.1 gives an overview of the occurrences for each species during the different years. The dot indicates the median: the day at which half of the occurrences are observed. The horizontal line shows the earliest and latest occurrence. The vertical bars on this line indicates the day at which 5% and 95% of the occurrences occur.

We define the migration period between 7 days prior to the 5% quantile and 7 days after the 95% quantile. This period contains at least 90% of the occurrences and includes occurrences close to the main period. Observations from outside these migration periods will be ignored.

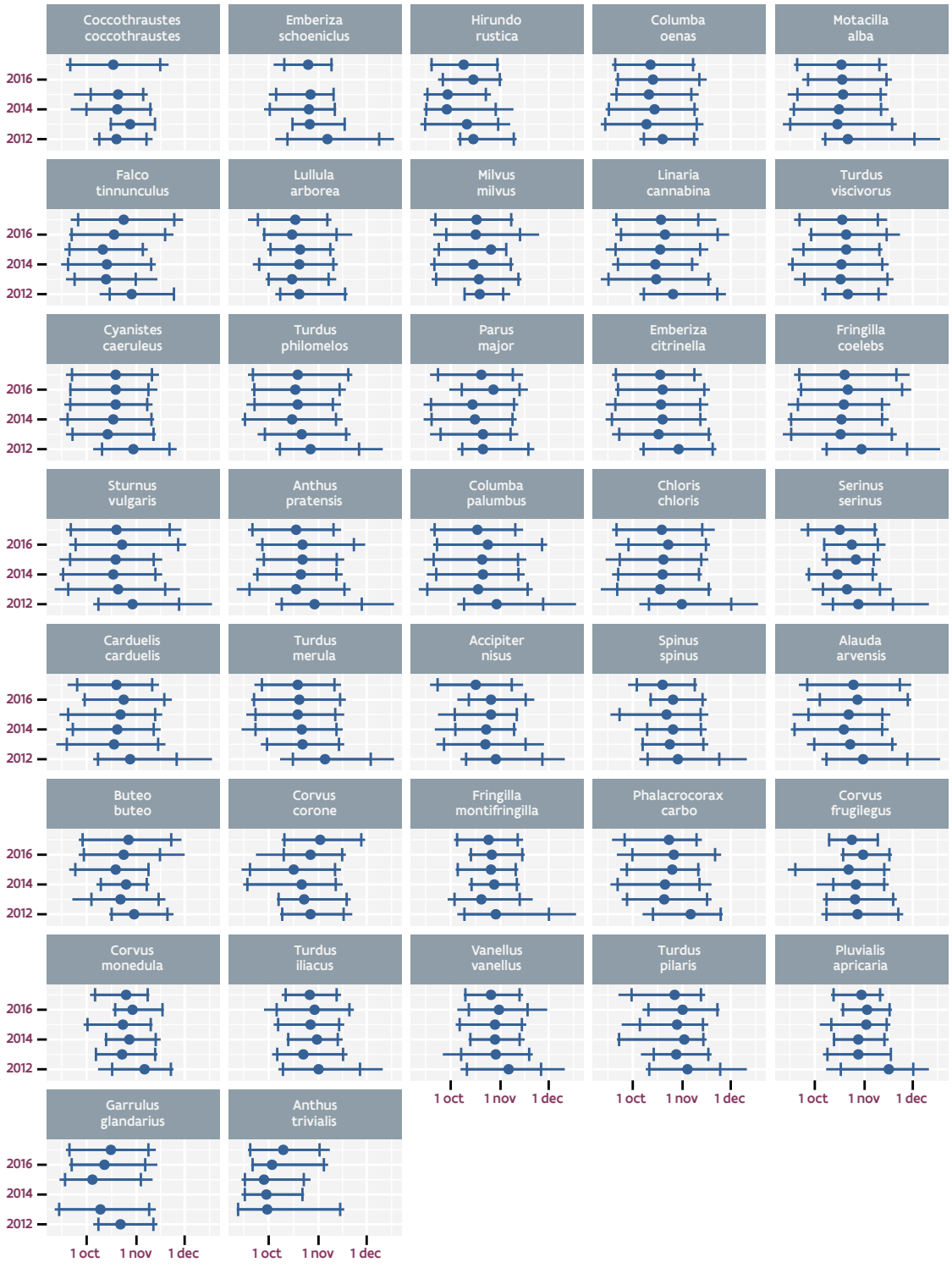

Figure 2.1: Observation period for each species in the different years. The dots represents the median. The line represents the full range from the first day to the last day with occurrences. The vertical bars indicate the period between 5% and 95% of the occurrences. Species are sorted by the median day of year averaged over the years.

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In order to get reasonable estimates for the effect of year, season and site, we need at least three visits per site in a given year. Table 2.3 lists the number of species observed at a given site. The number of species is split by the number of different years during which a species was observed at this site. E.g. at site "Beaudricourt" we have 35 species which are observed during 3 different years, and 2 other species are observed during only 2 years. Since we require at least 3 different years, the site "Beaudricourt" is only relevant for 35 species.

Table 2.3: Total number of species observed per site split by the number of years in which a species was observed.

site	1	2	3	4	5	6	sufficient
Baron					**4**	**33**	**37**
Beaudricourt		2	**35**				**35**
Boeschepe					**4**	**33**	**37**
Bouvigny Boyeffles	37						
Bray-Dunes	4	32					
Burelles		2	**35**				**35**
Cap d'Antifer				**3**	**34**		**37**
Chambord	3	34					
Col de la Pierre Sanglante	2	35					
Conteville				**3**	**34**		**37**
Croix	37						
Epineuse					**4**	**33**	**37**
Generville		2	**35**				**35**
Le Cailloux					**4**	**33**	**37**
Les Hayons	36						
Leurville	2	35					
Merville					**4**	**33**	**37**
Mesnil Caux	36						
Passa	37						
Plainval					**4**	**33**	**37**
Quend					**4**	**33**	**37**
Riaucourt	2	35					
Rully	2	35					
Serre de la Borie	2	35					
Sivry					**4**	**33**	**37**
St Samson	3	34					
Tardinghen					**4**	**33**	**37**
Tavaux	36						
Verjux	35						
Ville sur Ancre					**4**	**33**	**37**
Zuydcoote	3	34					

The sites are monitored during the early hours of the day, ranging from sunrise until four hours after sunrise. The observer notes the time of the observation as the number of hours after sunrise, rounded up to the next hour. So hour 1 is between sunrise and 1 hour after sunrise, hour 2 is between 1 hour after and 2 hours after sunrise, ... We count the number of days for each combination of site and "hour". Table 2.4 indicates that the majority of the observations are made during the forth hour. In order to avoid spurious effect on the trend, we decided to restrict the data to only the forth hour.

Table 2.4: Total number of visited days per site and per hour after sunrise.

site	1	2	3	4
Sivry	12	12	9	161
Tardinghen		5	1	78
Le Cailloux	2	3	8	59
Plainval	3	2	8	58
Cap d'Antifer		6	12	56
Quend	1	3	3	56
Boeschepe	2	4	2	53
Ville sur Ancre		1	4	50
Conteville		2	1	45
Beaudricourt	1	1	5	37
Epineuse	9	7	8	36
Merville		3	12	33
Baron		5	12	31
Burelles	3	2	6	30
Generville	5	8	10	28

Since we removed more observations, we recheck whether we have for each species at least 10 occurrences per year, 3 different years per site and 100 occurrences. Only the latter was not the case for every species. Those species are listed in table 2.5. They will be excluded from the analysis.

Table 2.5: Species with less than 100 occurrences after further screening

species	occurrences
Anthus trivialis	76
Coccothraustes coccothraustes	85
Emberiza schoeniclus	99
Milvus milvus	82
Serinus serinus	90

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3 STATISTICAL ANALYSIS

Generalised linear mixed models with negative binomial distribution were fitted to the data of each species. The long-term trend was fitted as either a linear or a non-linear trend along year. A first order random walk was used to model the seasonal pattern. Both a common seasonal pattern and a seasonal pattern per year were tested. The site effect was taken into account through a random intercept. All possible combinations of the long-term trend (linear and non-linear) and seasonal pattern (constant or different by year) were tested, hence 4 models per species. The best model is selected based on the Watanabe-Akaike information criterion (WAIC).

The best model is used to perform multiple imputation for the days within the migration period without visits. Then the total migration for each year is estimated by aggregating this augmented data set. Note that only a small fraction of the migration period is observed. So the augmented data is dominated by imputed data. Furthermore, this imputation implies that a bird passes through the area on a single day and will be seen at only one site. These might be very strong assumptions for some species. Therefore, the total migration requires careful interpretation.

The entire analysis was run in the statistical software `R` (R Core Team, 2019), using the `tidyverse` package (Wickham, 2017) for data wrangling, the `INLA` package (Rue et al, 2019) for fitting the models and the `multimput` package (Onkelinx et al, 2018) for multiple imputation.

Chapter 4 has a section with the summary for each species. The section starts with the list of the vernacular names in English, French and Dutch and the EURING code. Then an overview of the relevant migration period of each year is given.

Next the linear and non-linear long-term trends for the average site are shown. The line indicates the linear trend, the shaded area its uncertainty. The points indicate the non-linear trend, with error bars indicating the uncertainty. The caption of the figure indicates which one is the best. The models use the same seasonal pattern (common or one per year) as the best model. The index for the non-linear pattern is fixed at 100% in the first year (2012). The linear pattern is scaled accordingly.

When the best model has a common seasonal pattern for all the years, the figure shows a single plot with the relative effect of the dag of year. In the other case, the figure will show a subplot for each year.

The importance of each site is illustrated as an effect relative to the estimated effect of the site with the highest site effect.

The number of observations per site and per year is given. The total number of observations depends on the length of the migration period and thus will depend on the species and the year but not on the site. The sites were not visited on each day during the migration period. For such days we will need to impute the number of migrating birds. Therefore it is important to get a feeling of the number of imputed observations.

The last figure displays the total number of migrating birds per year after imputation.

4 RESULTS

The yearly change assuming a linear trend is given in the table below. Please note that carefull interpretation is required when the trend pattern is non-linear. In such case one need to compare the linear trend with the indices. The seasonality indicates weither the same seasonal pattern is used for every year or the seasonal pattern changes for each year. The classification is based on following rules:

- **strong increase (++)**: increase significantly more than doubling every 15 year[1]
- **increase (+)**: significant increase, uncertain weither is is stronger than doubling every 15 year
- **strong decrease (−−)**: descrease significantly stronger than halving every 15 year[2]
- **decrease (+)**: significant decrease, uncertain weither is is stronger than halving every 15 year
- **potential increase (?+)**: non-significant increase, the potential decrease is not stronger than halving every 15 year
- **potential decrease (?−)**: non-significant decrease, the potential increase is not stronger than double every 15 year
- **uncertain trend (?)**: non-significant trend, could be both as strong as doubling or halving every 15 year

Table 4.1: Estimates of the yearly linear change. The species name links to the details of the species.

Scientific name	Trend	Class	Trend pattern	Seasonality
Corvus monedula	+42% (+15%; +74%)	++	linear	stable
Phalacrocorax carbo	+14% (+0%; +30%)	+	non-linear	yearly
Linaria cannabina	+11% (+1%; +21%)	+	non-linear	yearly
Turdus merula	+10% (+0%; +22%)	+	non-linear	yearly
Emberiza citrinella	-16% (-27%; -4%)	−	linear	yearly
Chloris chloris	-13% (-24%; -1%)	−	non-linear	yearly
Corvus frugilegus	-56% (-64%; -46%)	−−	non-linear	yearly
Vanellus vanellus	-30% (-41%; -17%)	−−	linear	stable
Spinus spinus	-26% (-37%; -14%)	−−	linear	stable
Columba palumbus	-22% (-35%; -6%)	−−	non-linear	yearly
Corvus corone	-22% (-33%; -8%)	−−	non-linear	yearly
Garrulus glandarius	-14% (-23%; -5%)	−−	non-linear	yearly
Carduelis carduelis	+9% (-1%; +21%)	?+	linear	stable
Alauda arvensis	-9% (-20%; +3%)	?−	non-linear	yearly
Accipiter nisus	-9% (-17%; +0%)	?−	non-linear	yearly
Pluvialis apricaria	+19% (-5%; +51%)	?	linear	yearly
Turdus pilaris	-13% (-32%; +11%)	?	non-linear	yearly
Parus major	+10% (-12%; +36%)	?	non-linear	yearly
Turdus philomelos	+8% (-7%; +25%)	?	non-linear	yearly

[1] equivalent to a yearly change of +4.7%
[2] equivalent to a yearly change of -4.5%

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Scientific name	Trend	Class	Trend pattern	Seasonality
Turdus iliacus	-7% (-19%; +7%)	?	non-linear	yearly
Anthus pratensis	+6% (-6%; +20%)	?	linear	yearly
Fringilla montifringilla	+6% (-12%; +28%)	?	non-linear	yearly
Columba oenas	-5% (-17%; +8%)	?	linear	stable
Fringilla coelebs	-3% (-15%; +10%)	?	non-linear	yearly
Hirundo rustica	-3% (-17%; +13%)	?	linear	stable
Falco tinnunculus	-3% (-12%; +7%)	?	linear	stable
Turdus viscivorus	-3% (-14%; +9%)	?	non-linear	yearly
Motacilla alba	-2% (-14%; +11%)	?	non-linear	yearly
Cyanistes caeruleus	-2% (-17%; +15%)	?	non-linear	yearly
Lullula arborea	-2% (-17%; +15%)	?	linear	yearly
Sturnus vulgaris	+0% (-9%; +11%)	?	non-linear	yearly

Table 4.2: Overview of all analysed species with their vernacular names in English, French and Dutch. The scientific name has a clickable link to the details of the species.

Scientific name	EURING	English	French	Dutch
Phalacrocorax carbo	721	great cormorant	grand cormoran atlantique	aalscholver
Accipiter nisus	2690	Eurasian sparrowhawk	épervier dEurope	sperwer
Falco tinnunculus	3040	common kestrel	faucon crécerelle	torenvalk
Pluvialis apricaria	4851	European golden plover	pluvier doré	goudplevier
Vanellus vanellus	4930	northern lapwing	vanneau huppé	kievit
Columba oenas	6680	stock dove	pigeon colombin	holenduif
Columba palumbus	6700	common wood pigeon	pigeon ramier	houtduif
Lullula arborea	9740	woodlark	alouette lulu	boomleeuwerik
Alauda arvensis	9760	skylark	alouette des champs	veldleeuwerik
Hirundo rustica	9920	barn swallow	hirondelle de cheminée	boerenzwaluw
Anthus pratensis	10110	meadow pipit	pipit farlouse	graspieper
Motacilla alba	10200	white wagtail	bergeronnette grise	witte kwikstaart
Turdus merula	11870	blackbird	merle noir	merel
Turdus pilaris	11980	fieldfare	grive litorne	kramsvogel
Turdus philomelos	12000	song thrush	grive musicienne	zanglijster
Turdus iliacus	12010	redwing	grive mauvis	koperwiek
Turdus viscivorus	12020	mistle thrush	grive draine	grote lijster
Cyanistes caeruleus	14620	Eurasian blue tit	mésange bleue	Pimpelmees
Parus major	14640	great tit	mésange charbonnière	koolmees
Garrulus glandarius	15390	jay	geai des chênes	gaai
Corvus monedula	15600	jackdaw	choucas des tours	kauw
Corvus frugilegus	15630	rook	corbeau freux	roek
Corvus corone	15670	carrion crow	corneille noire	zwarte kraai
Sturnus vulgaris	15820	starling	étourneau sansonnet	spreeuw

Scientific name	EURING	English	French	Dutch
Fringilla coelebs	16360	chaffinch	pinson des arbres	vink
Fringilla montifringilla	16380	brambling	pinson du nord	keep
Chloris chloris	16490	European greenfinch	verdier d'Europe	Groenling
Carduelis carduelis	16530	goldfinch	chardonneret élégant	putter
Spinus spinus	16540	Eurasian siskin	tarin des aulnes	Sijs
Linaria cannabina	16600	common linnet	linotte mélodieuse	Kneu
Emberiza citrinella	18570	yellowhammer	bruant jaune	geelgors

4.1 *PHALACROCORAX CARBO*

- English: great cormorant
- French: grand cormoran atlantique
- Dutch: aalscholver
- EURING: 721

More information on *Phalacrocorax carbo*: https://www.gbif.org/species/2481890

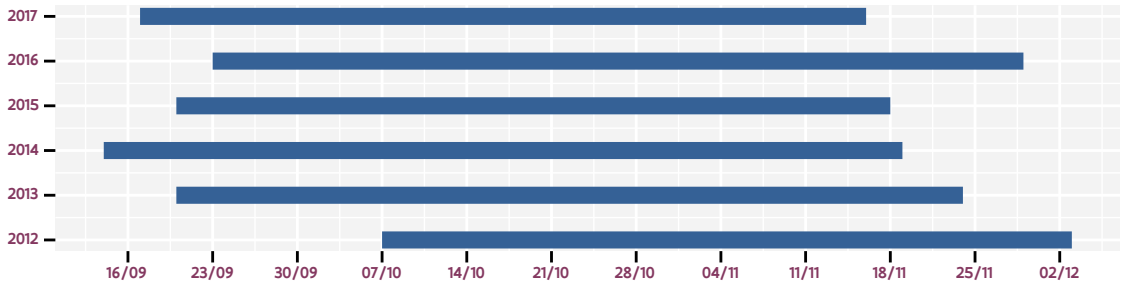

Figure 4.1: Migration periods used for *Phalacrocorax carbo*.

https://doi.org/10.21436/inbor.16917180

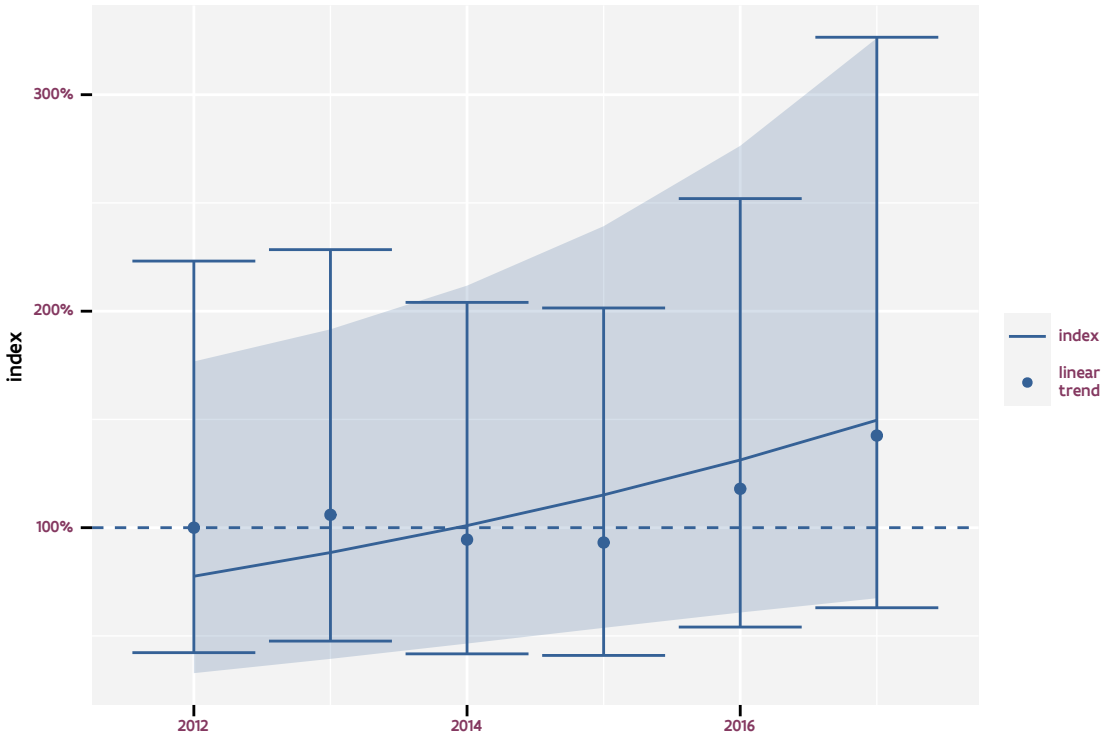

Figure 4.2: Indices and linear trend for *Phalacrocorax carbo*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

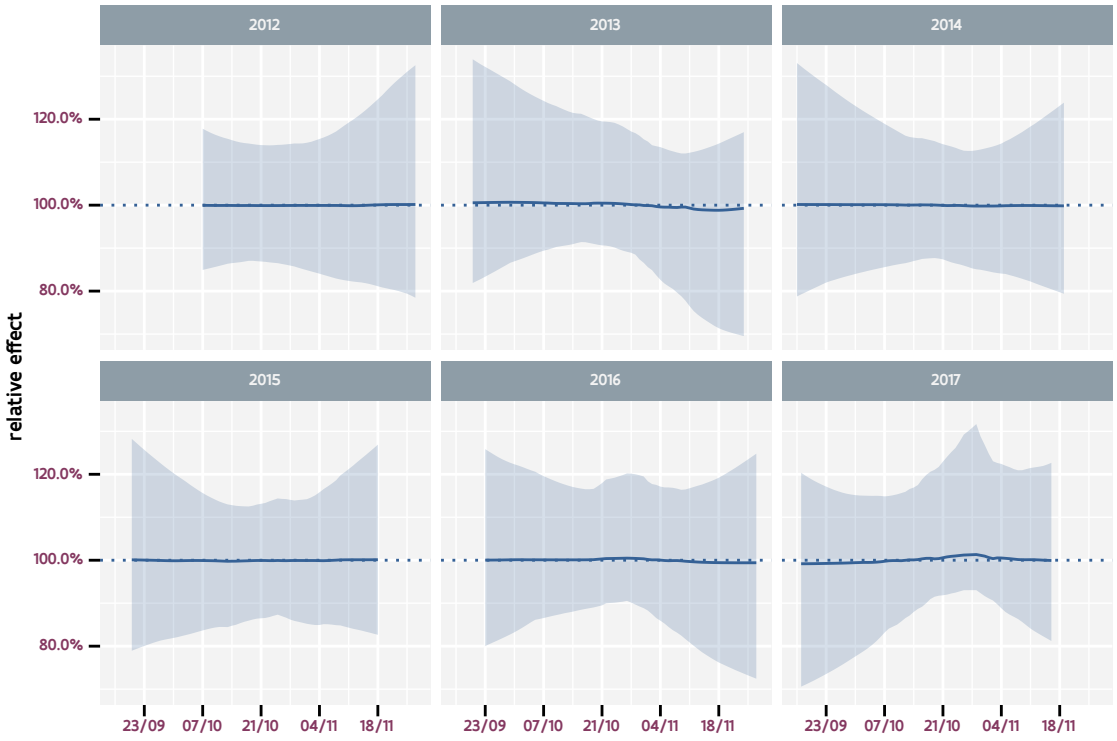

Figure 4.3: Seasonal pattern for *Phalacrocorax carbo*.

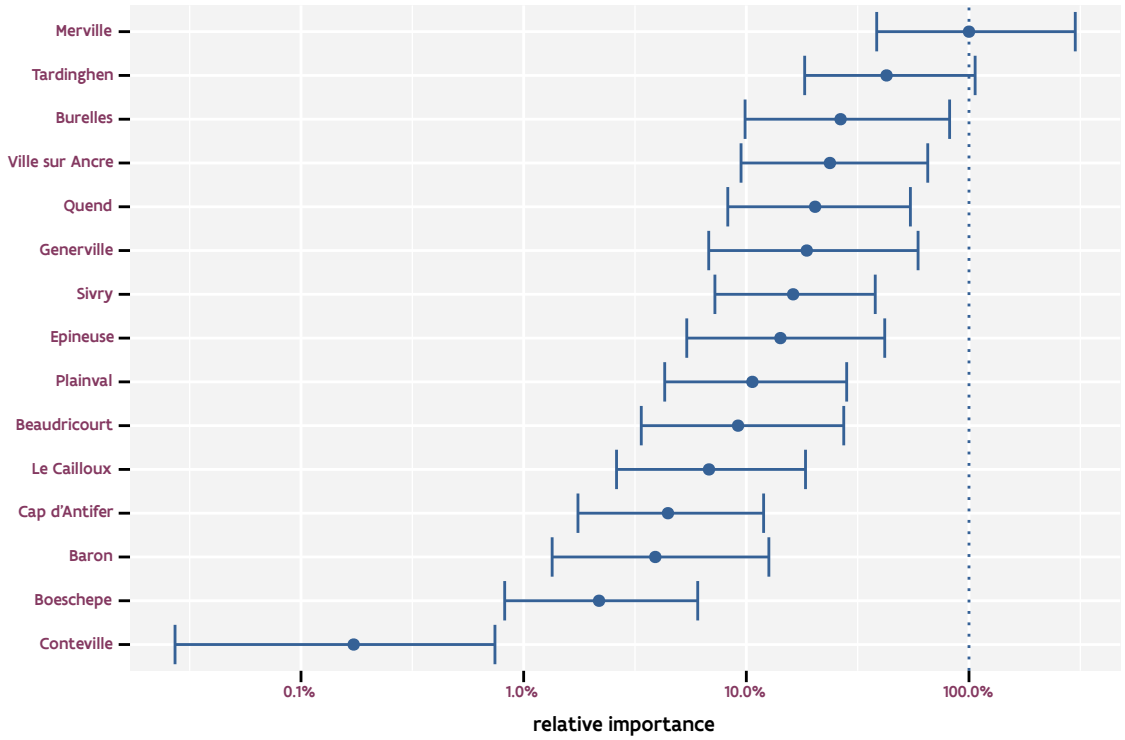

Figure 4.4: Relative importance per site for *Phalacrocorax carbo*.

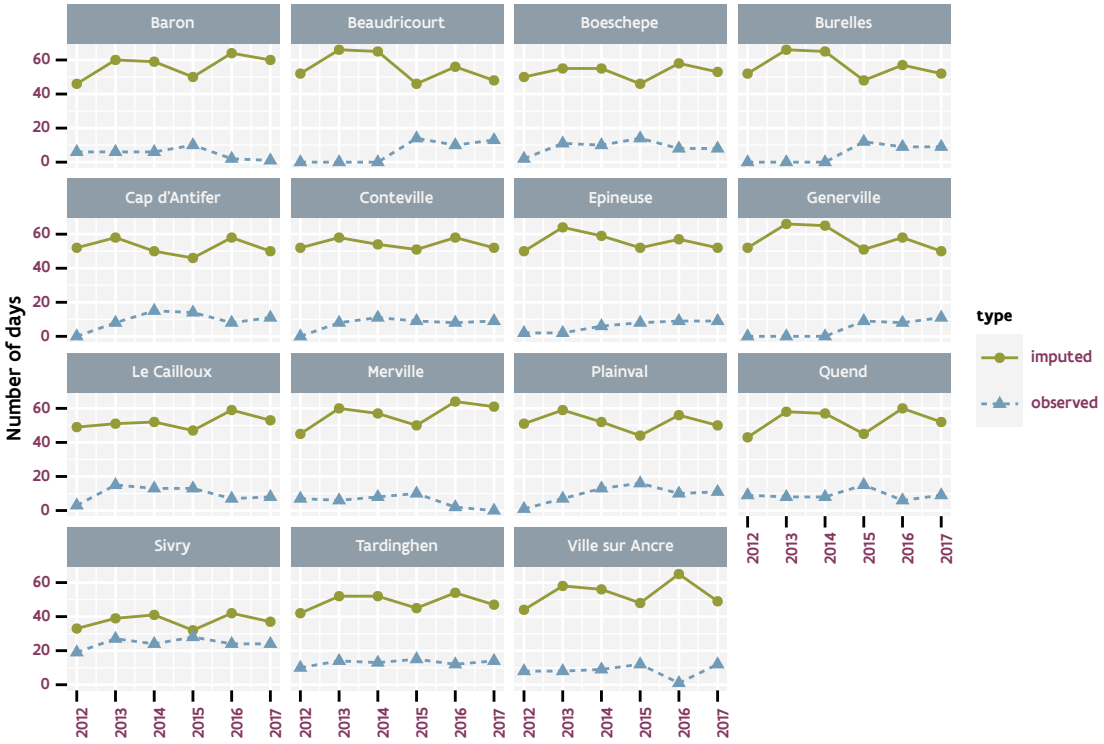

Figure 4.5: Number of days with observations per site and per year for *Phalacrocorax carbo*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

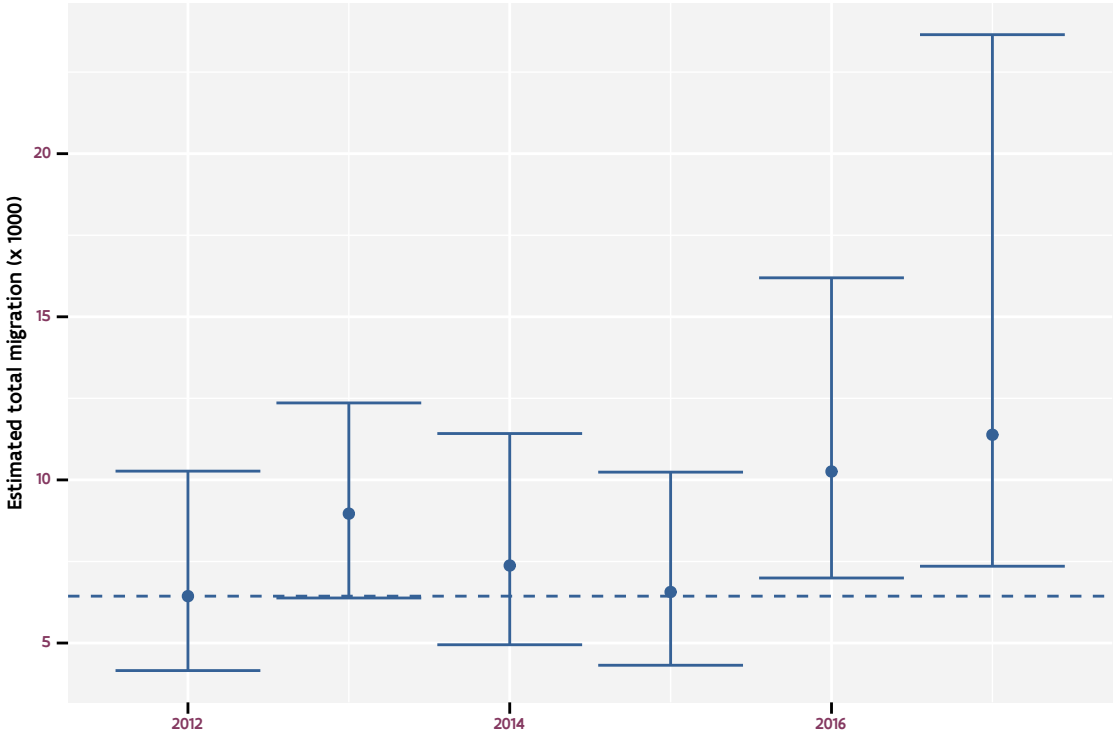

Figure 4.6: Imputed total of *Phalacrocorax carbo* during the migration period.

4.2 *ACCIPITER NISUS*

- English: Eurasian sparrowhawk
- French: épervier dEurope
- Dutch: sperwer
- EURING: 2690

More information on *Accipiter nisus*: https://www.gbif.org/species/2480637

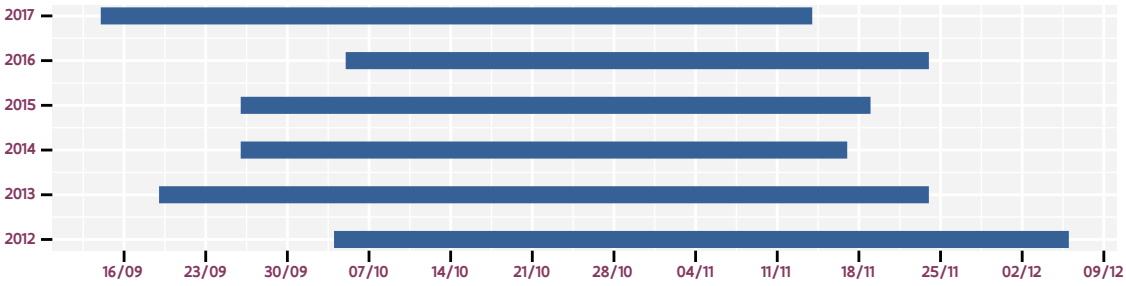

Figure 4.7: Migration periods used for *Accipiter nisus*.

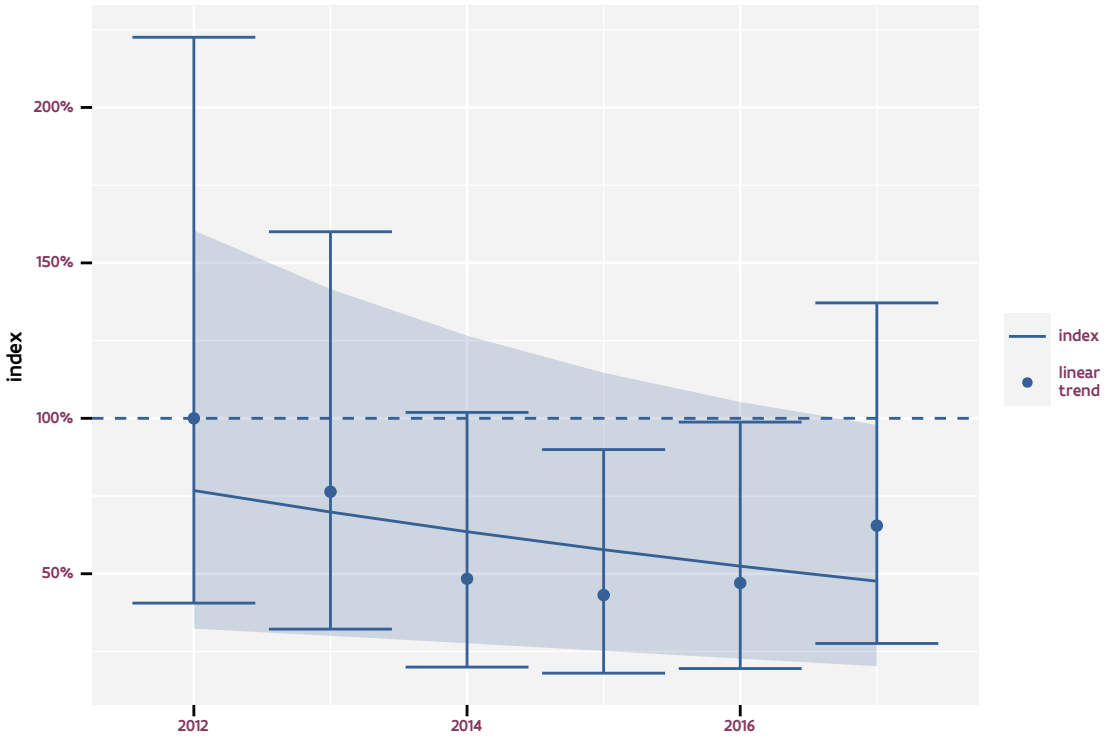

Figure 4.8: Indices and linear trend for *Accipiter nisus*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

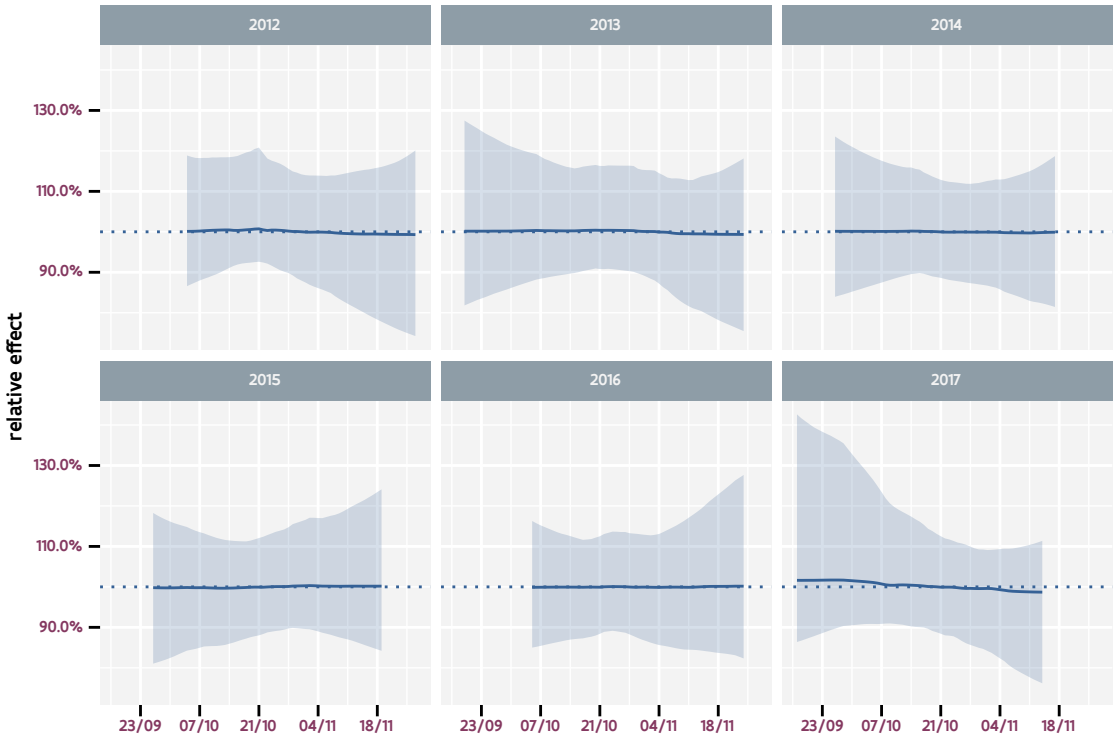

Figure 4.9: Seasonal pattern for *Accipiter nisus*.

https://doi.org/10.21436/inbor.16917180

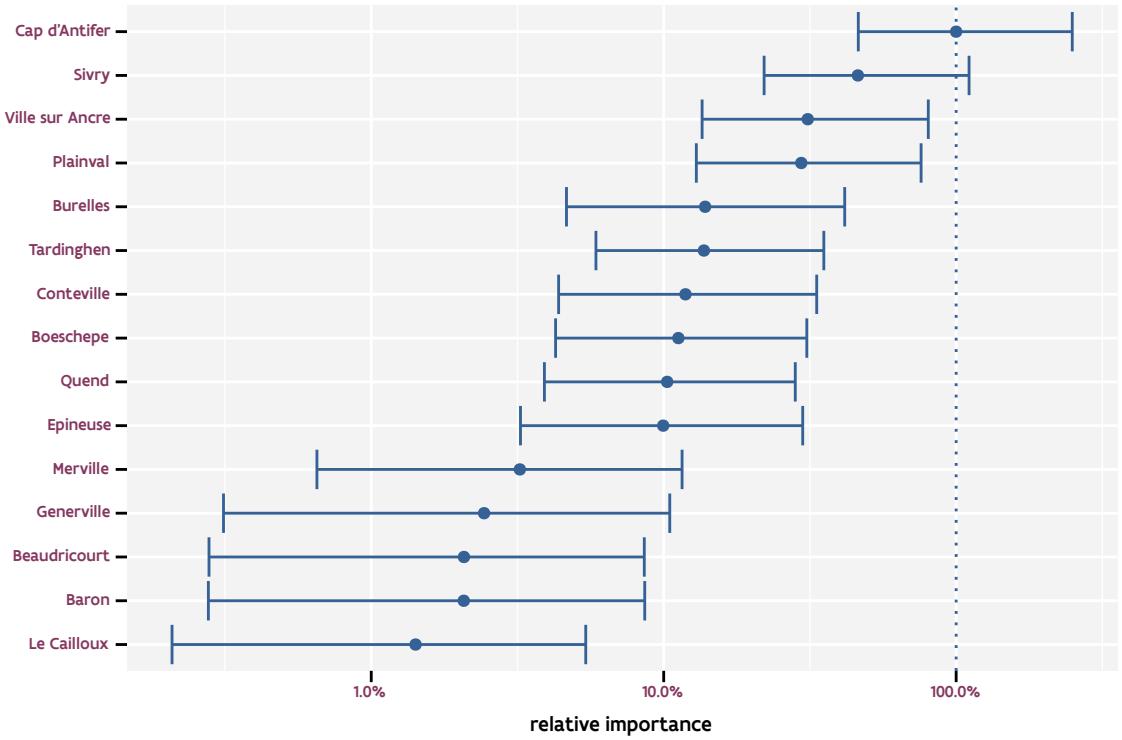

Figure 4.10: Relative importance per site for *Accipiter nisus*.

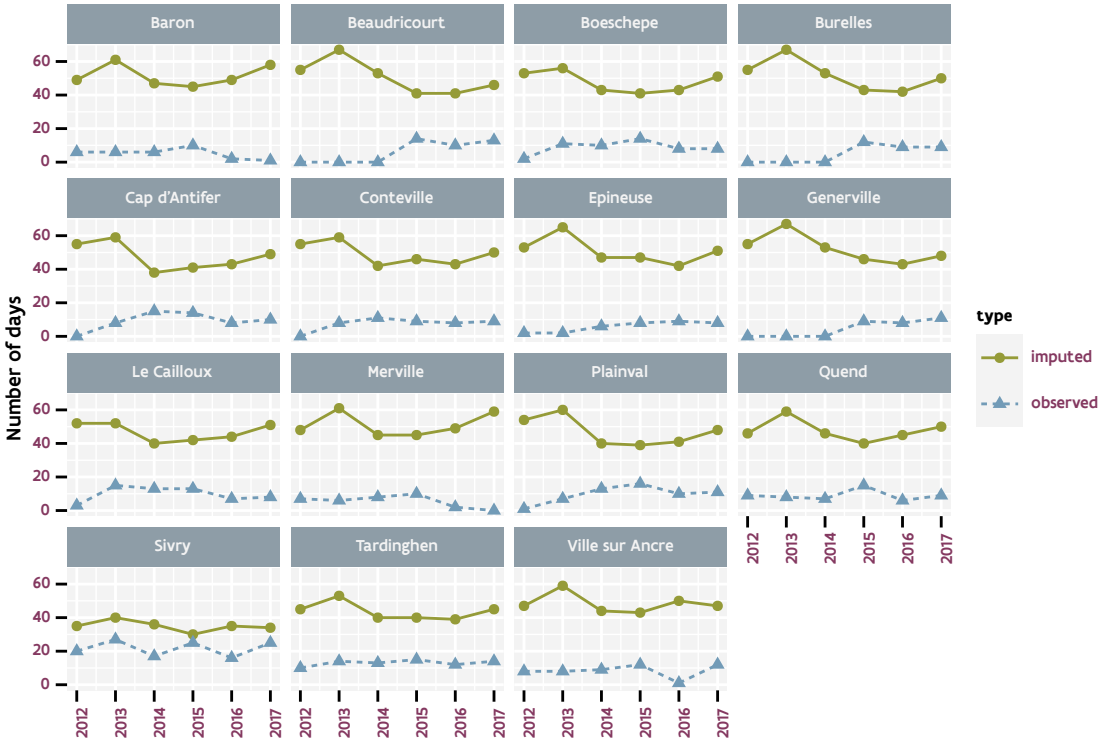

Figure 4.11: Number of days with observations per site and per year for *Accipiter nisus*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

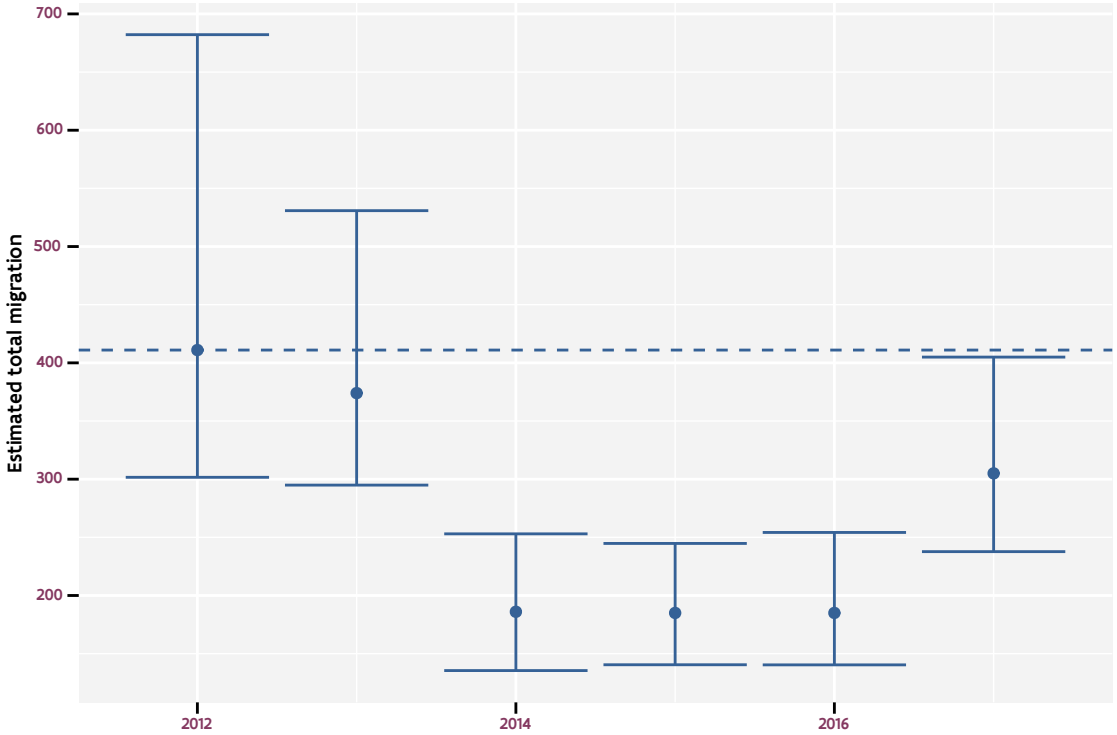

Figure 4.12: Imputed total of *Accipiter nisus* during the migration period.

4.3 *FALCO TINNUNCULUS*

- English: common kestrel
- French: faucon crécerelle
- Dutch: torenvalk
- EURING: 3040

More information on *Falco tinnunculus*: https://www.gbif.org/species/9616058

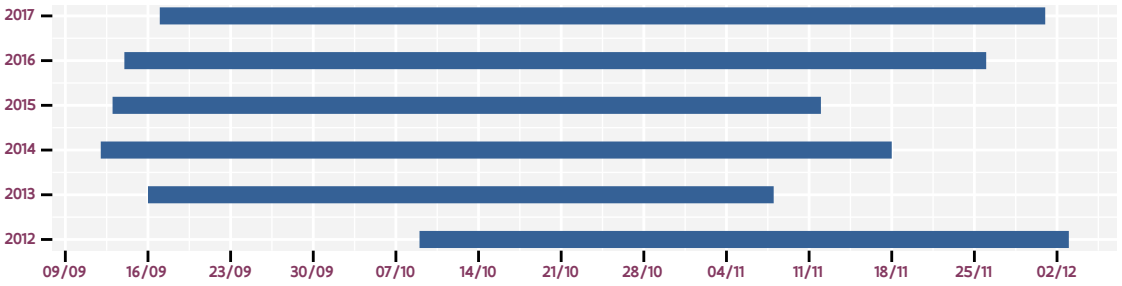

Figure 4.13: Migration periods used for *Falco tinnunculus*.

https://doi.org/10.21436/inbor.16917180

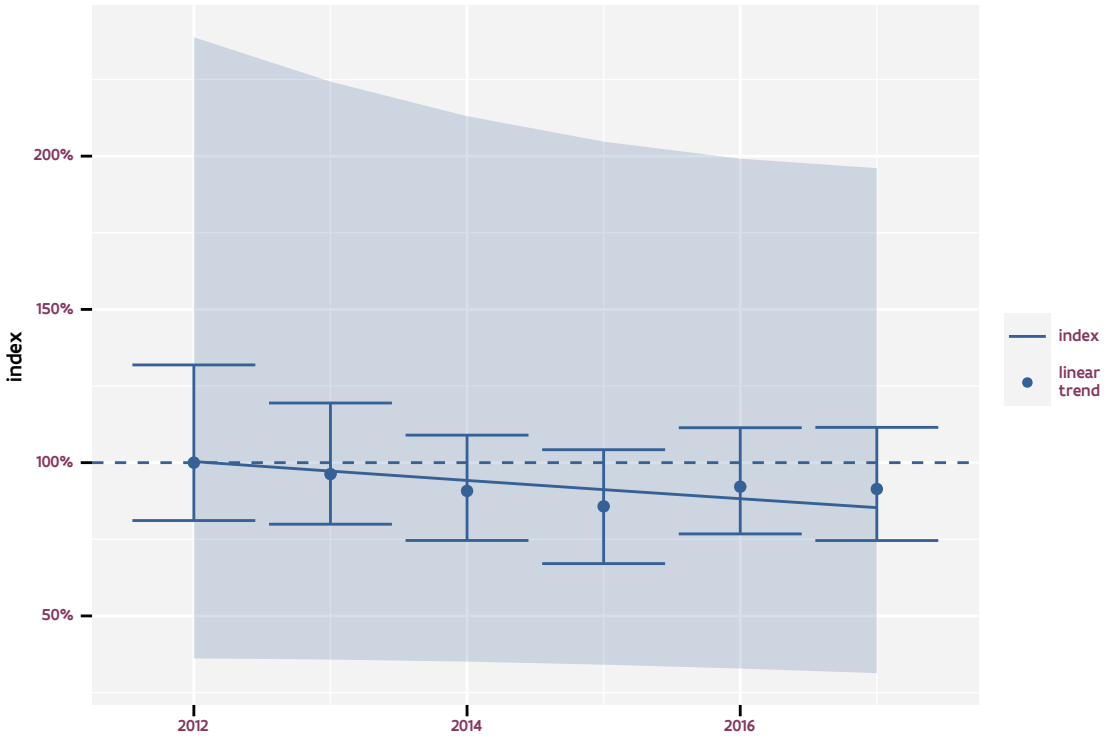

Figure 4.14: Indices and linear trend for *Falco tinnunculus*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

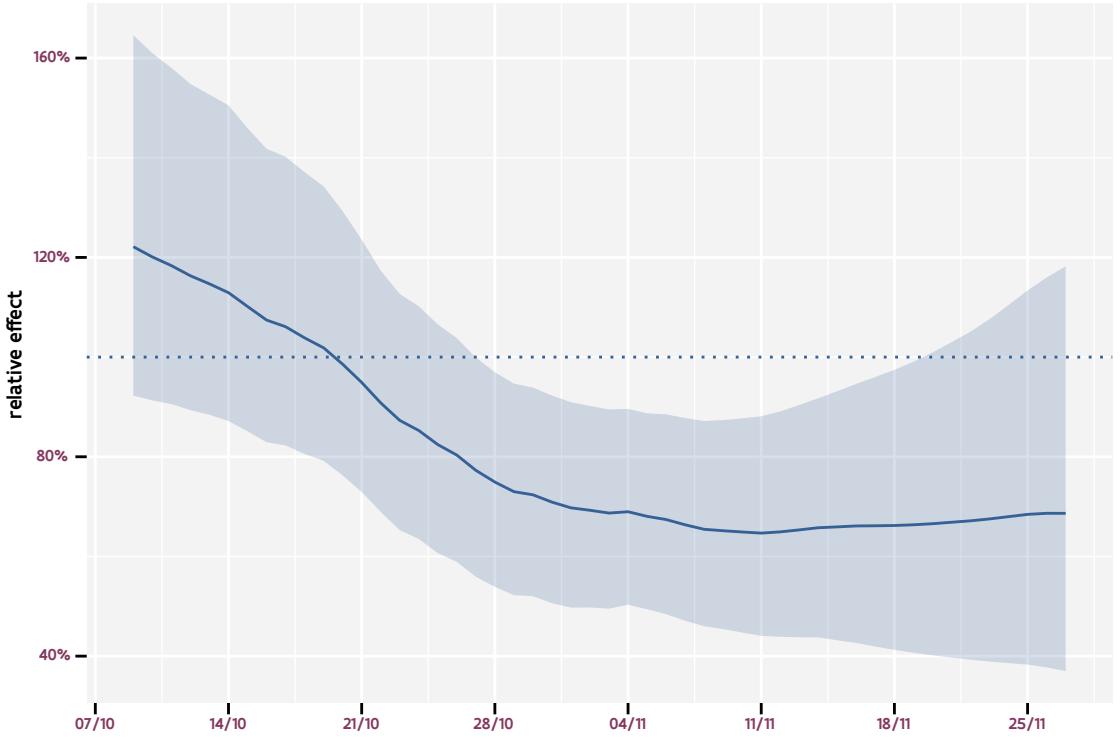

Figure 4.15: Seasonal pattern for *Falco tinnunculus*.

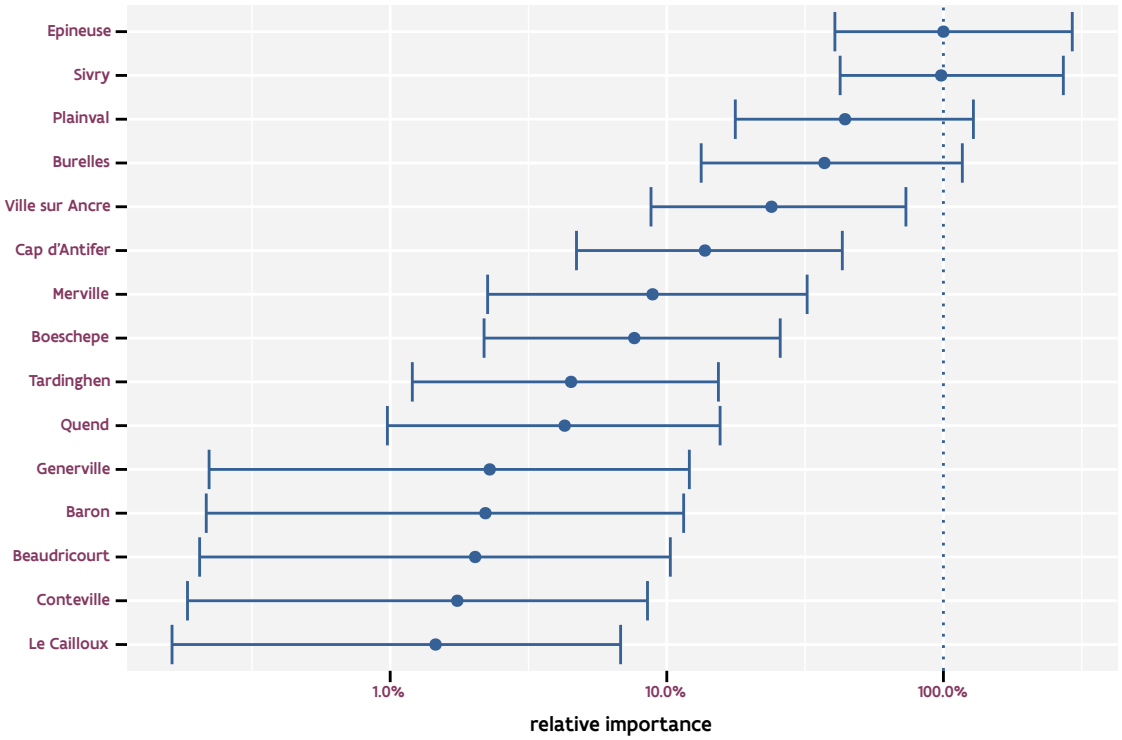

Figure 4.16: Relative importance per site for *Falco tinnunculus*.

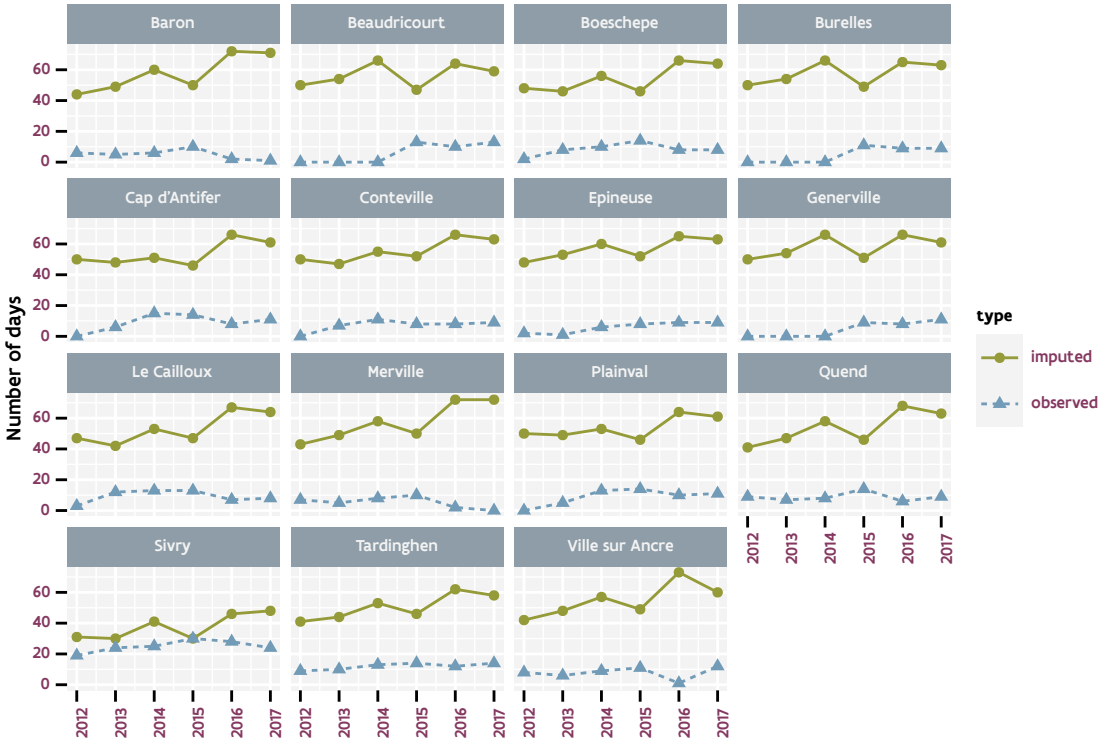

Figure 4.17: Number of days with observations per site and per year for *Falco tinnunculus*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

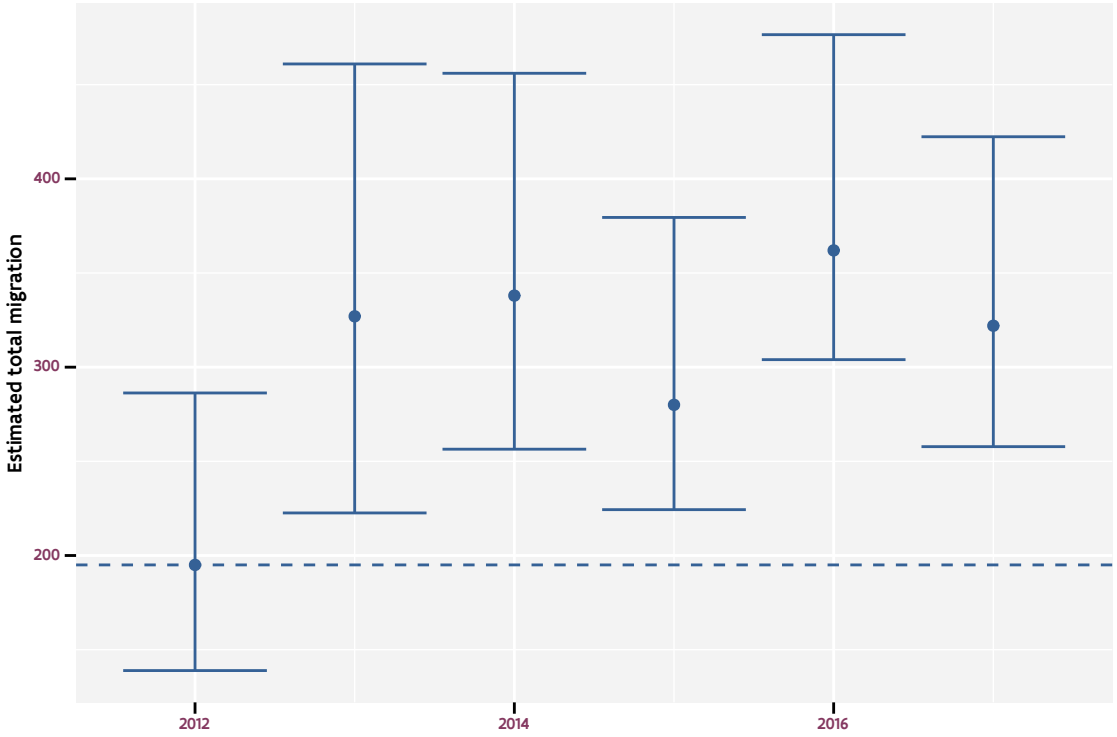

Figure 4.18: Imputed total of *Falco tinnunculus* during the migration period.

4.4 *PLUVIALIS APRICARIA*

- English: European golden plover
- French: pluvier doré
- Dutch: goudplevier
- EURING: 4851

More information on *Pluvialis apricaria*: https://www.gbif.org/species/2480332

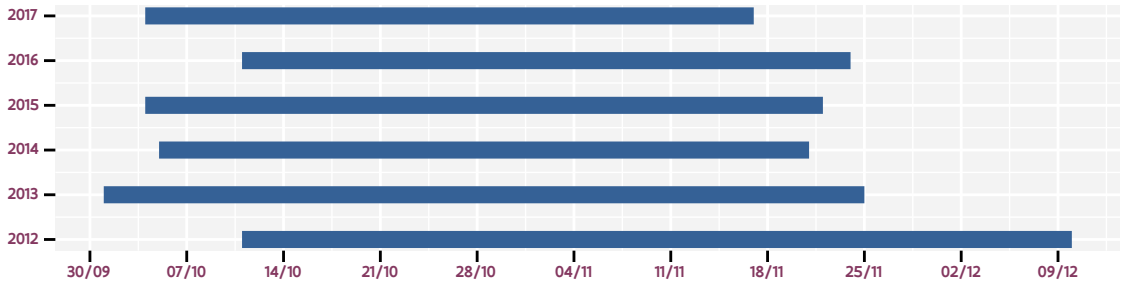

Figure 4.19: Migration periods used for *Pluvialis apricaria*.

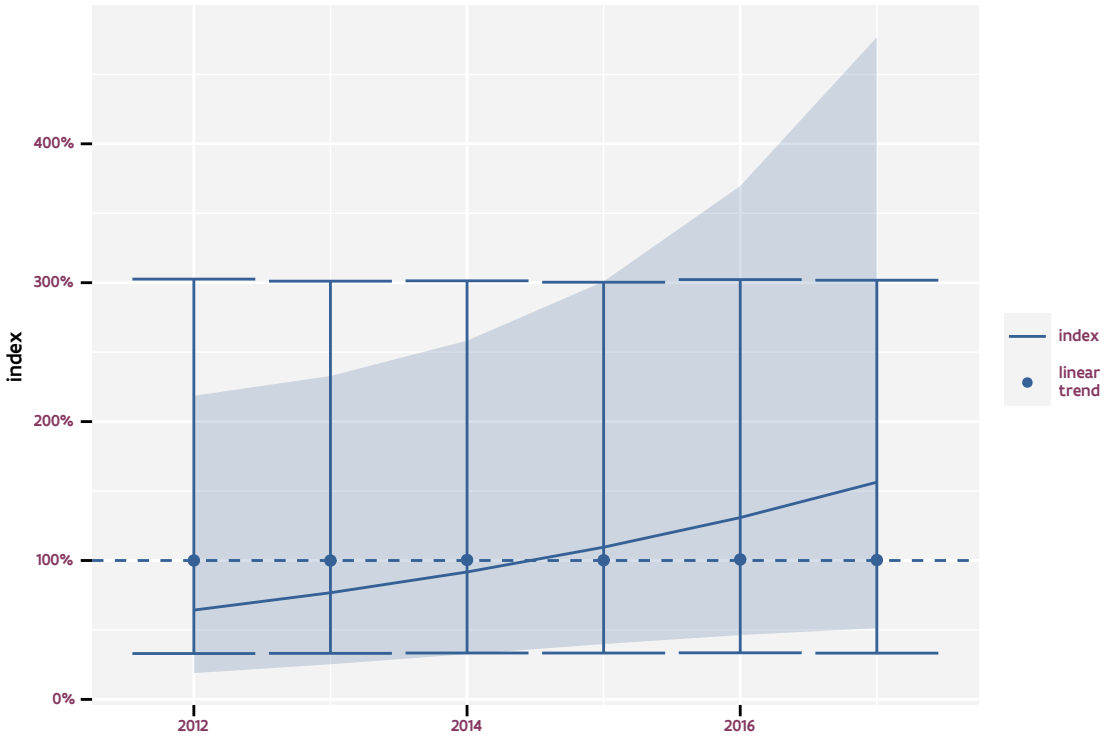

Figure 4.20: Indices and linear trend for *Pluvialis apricaria*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

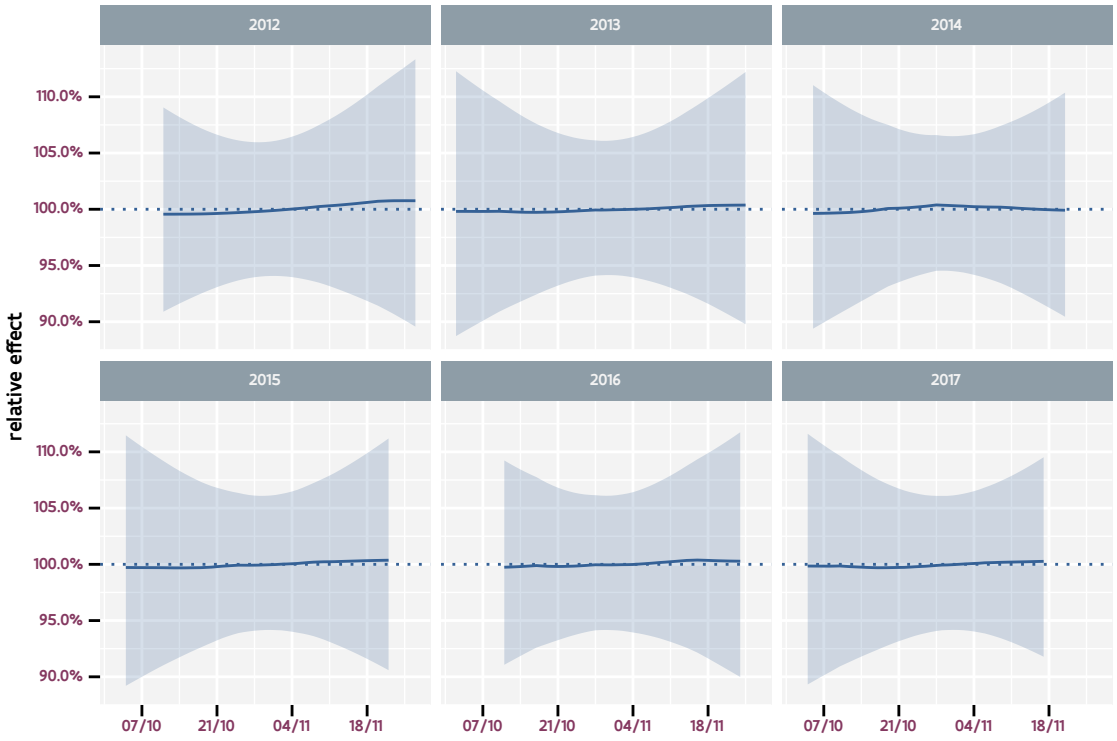

Figure 4.21: Seasonal pattern for *Pluvialis apricaria*.

https://doi.org/10.21436/inbor.16917180

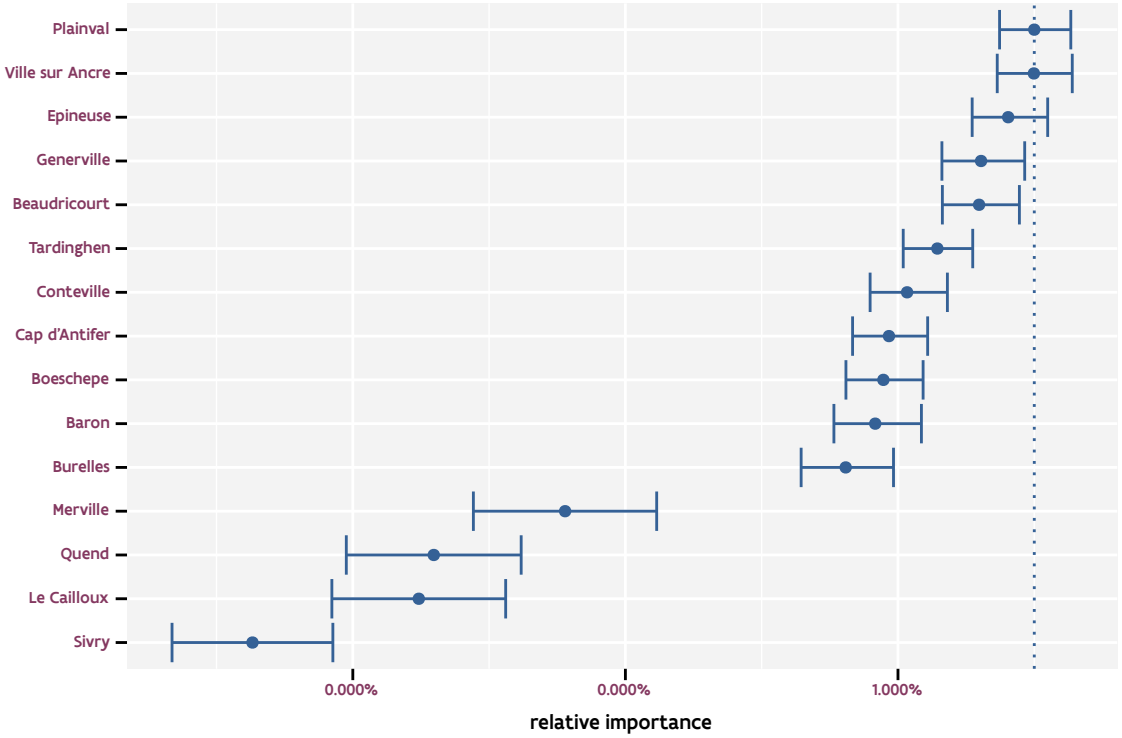

Figure 4.22: Relative importance per site for *Pluvialis apricaria*.

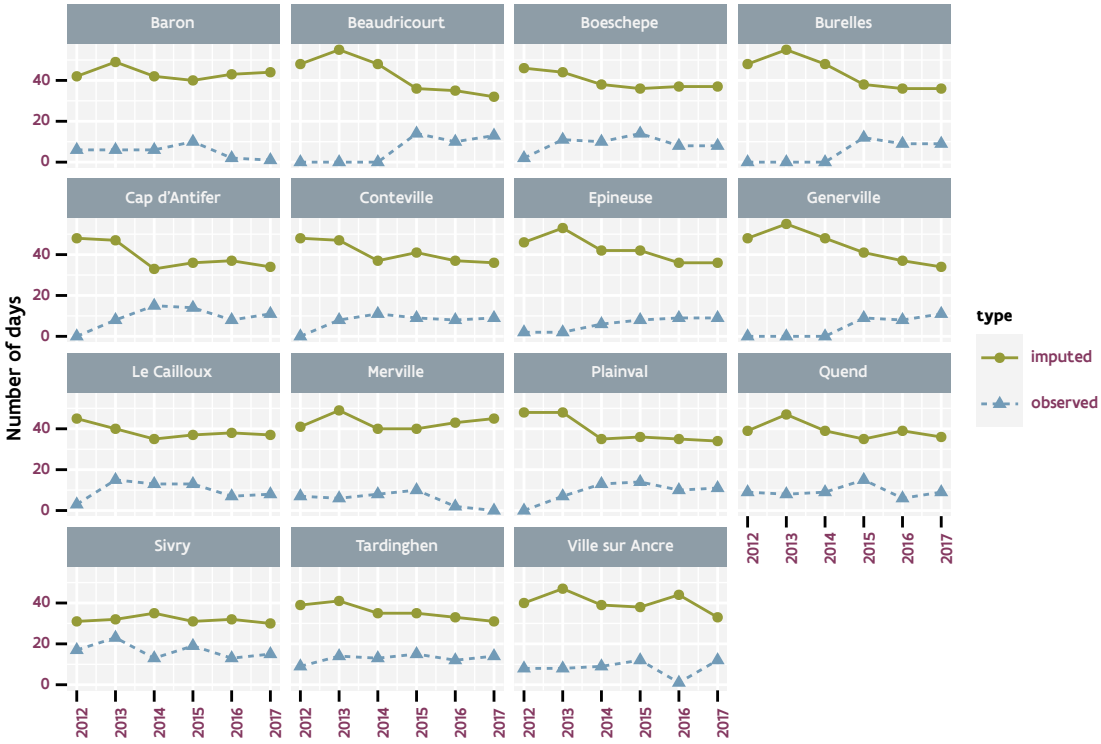

Figure 4.23: Number of days with observations per site and per year for *Pluvialis apricaria*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

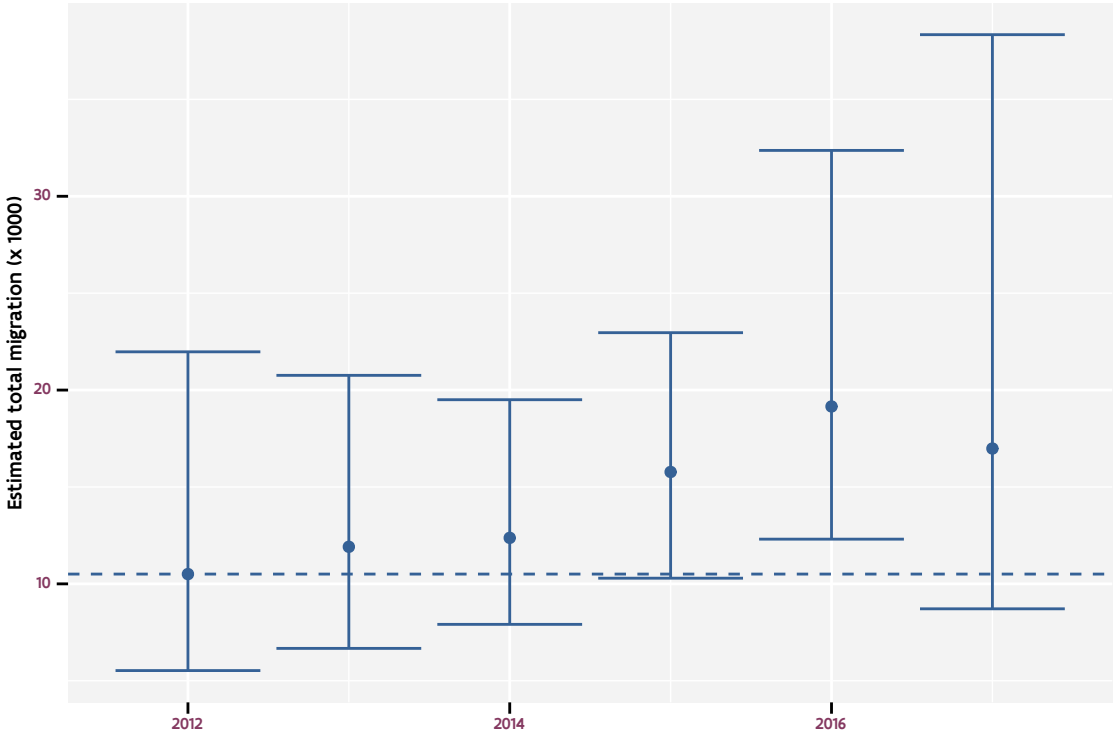

Figure 4.24: Imputed total of *Pluvialis apricaria* during the migration period.

4.5 *VANELLUS VANELLUS*

- English: northern lapwing
- French: vanneau huppé
- Dutch: kievit
- EURING: 4930

More information on *Vanellus vanellus*: https://www.gbif.org/species/2480242

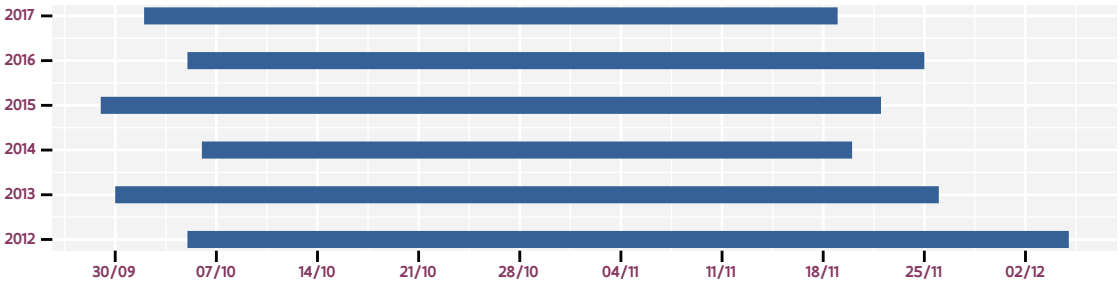

Figure 4.25: Migration periods used for *Vanellus vanellus*.

https://doi.org/10.21436/inbor.16917180

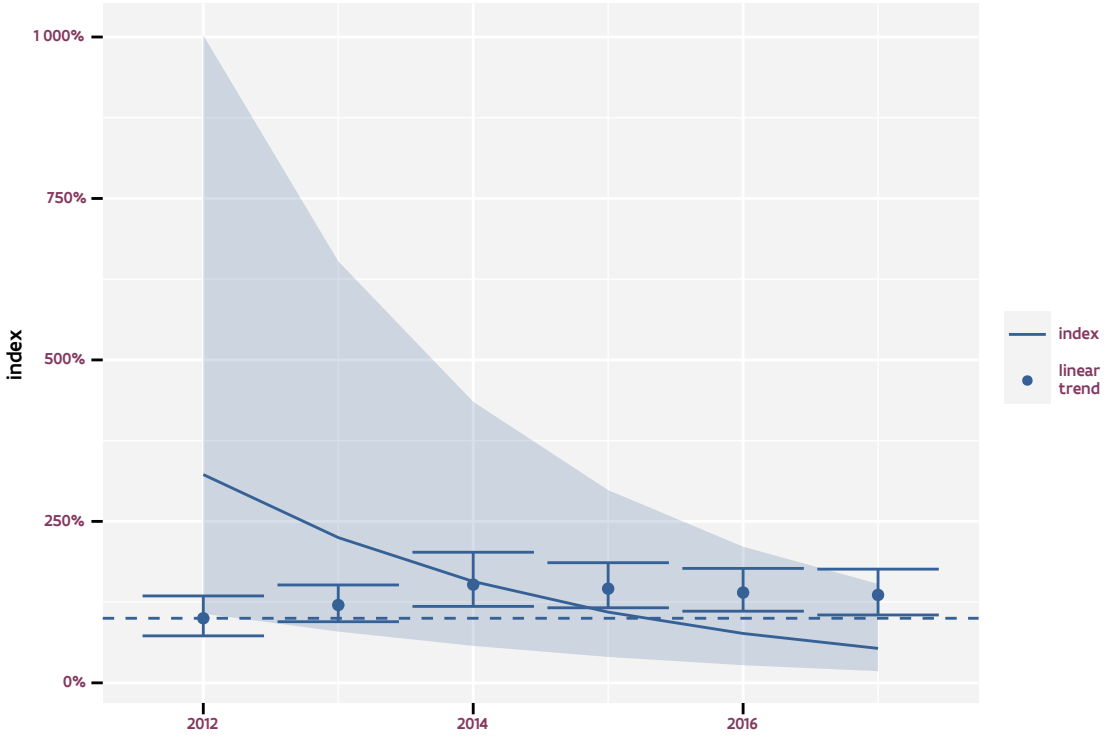

Figure 4.26: Indices and linear trend for *Vanellus vanellus*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

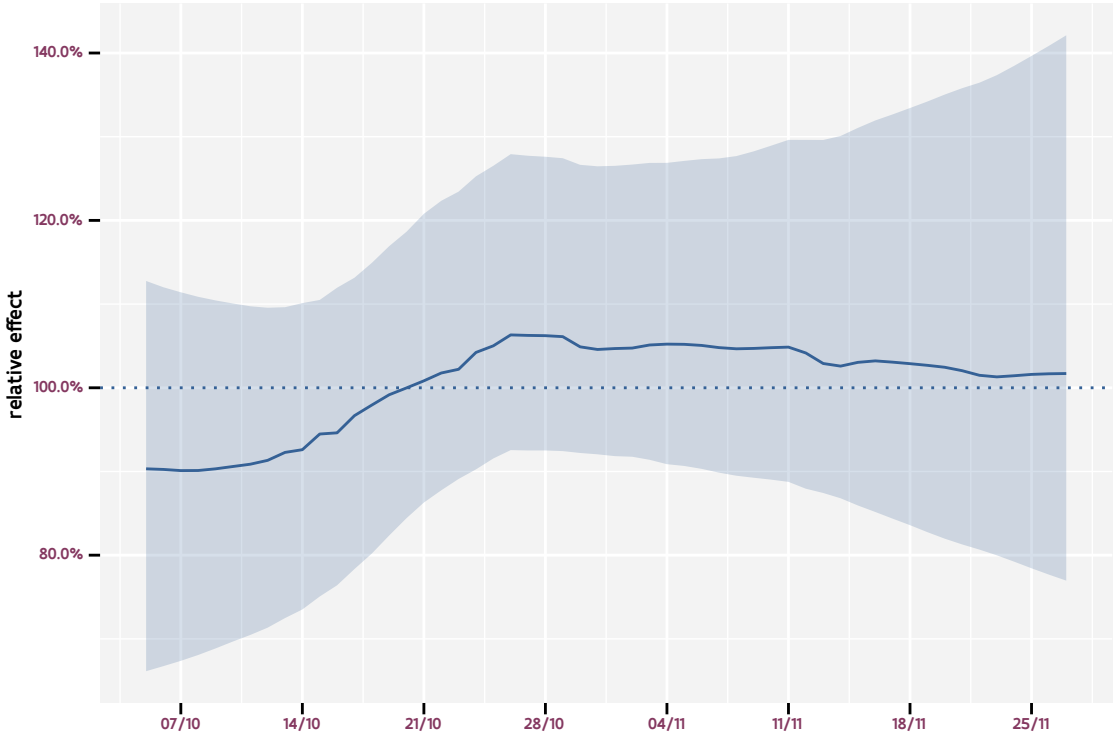

Figure 4.27: Seasonal pattern for *Vanellus vanellus*.

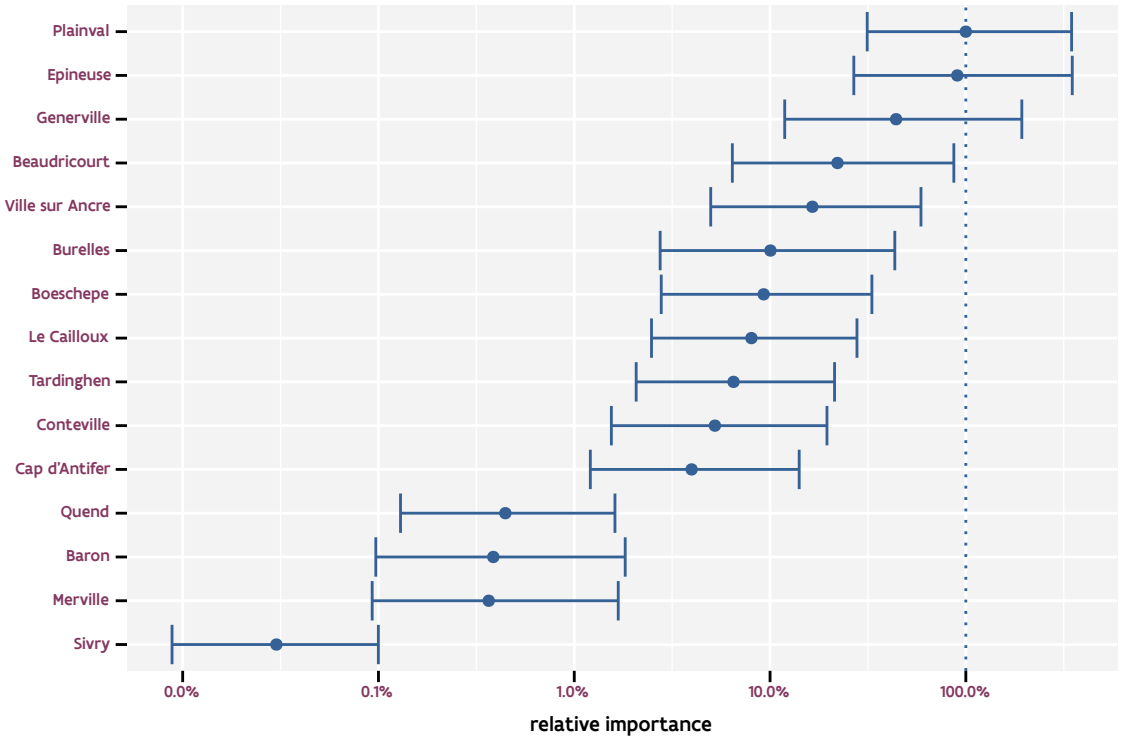

Figure 4.28: Relative importance per site for *Vanellus vanellus*.

Figure 4.29: Number of days with observations per site and per year for *Vanellus vanellus*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

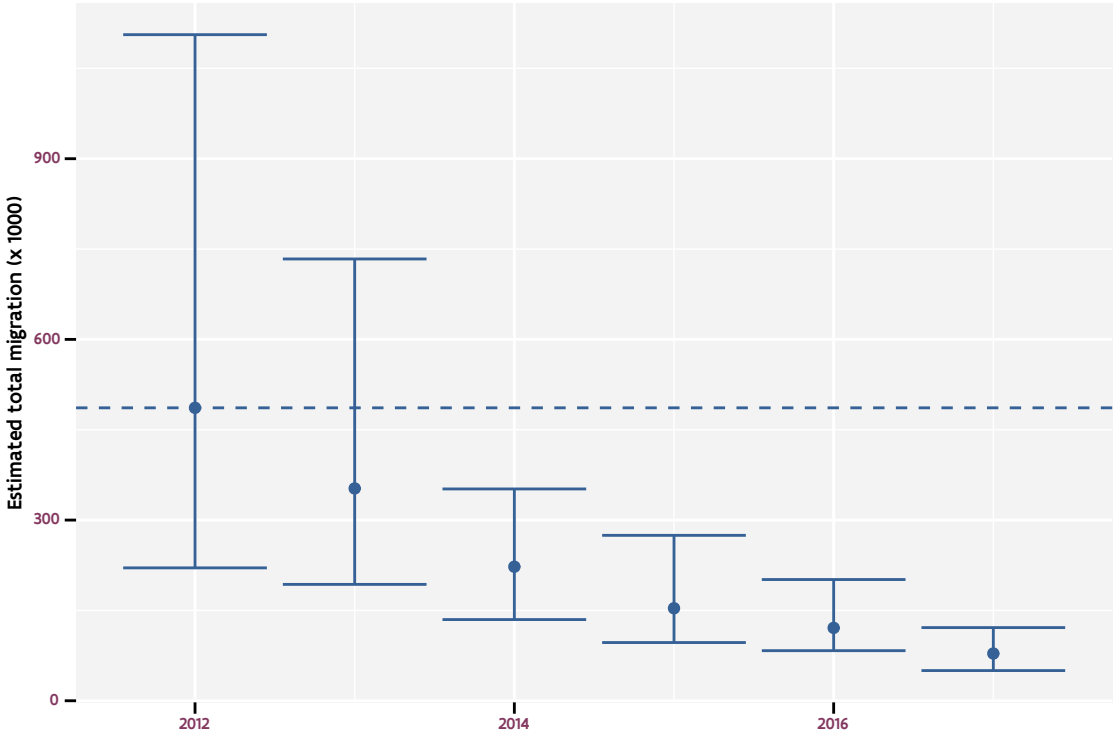

Figure 4.30: Imputed total of *Vanellus vanellus* during the migration period.

4.6 *COLUMBA OENAS*

- English: stock dove
- French: pigeon colombin
- Dutch: holenduif
- EURING: 6680

More information on *Columba oenas*: https://www.gbif.org/species/2495471

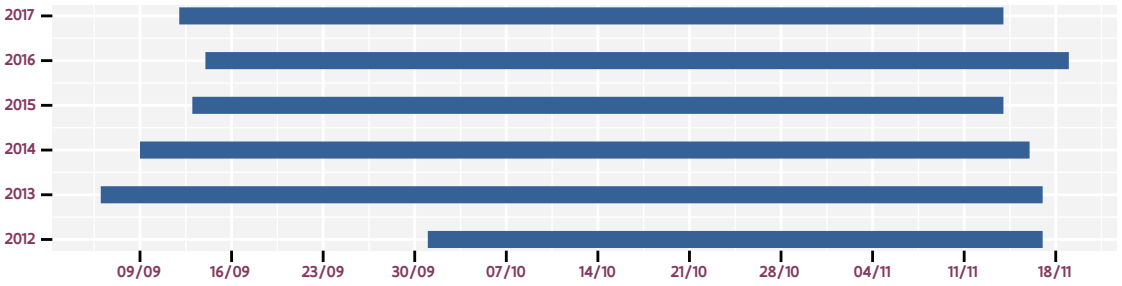

Figure 4.31: Migration periods used for *Columba oenas*.

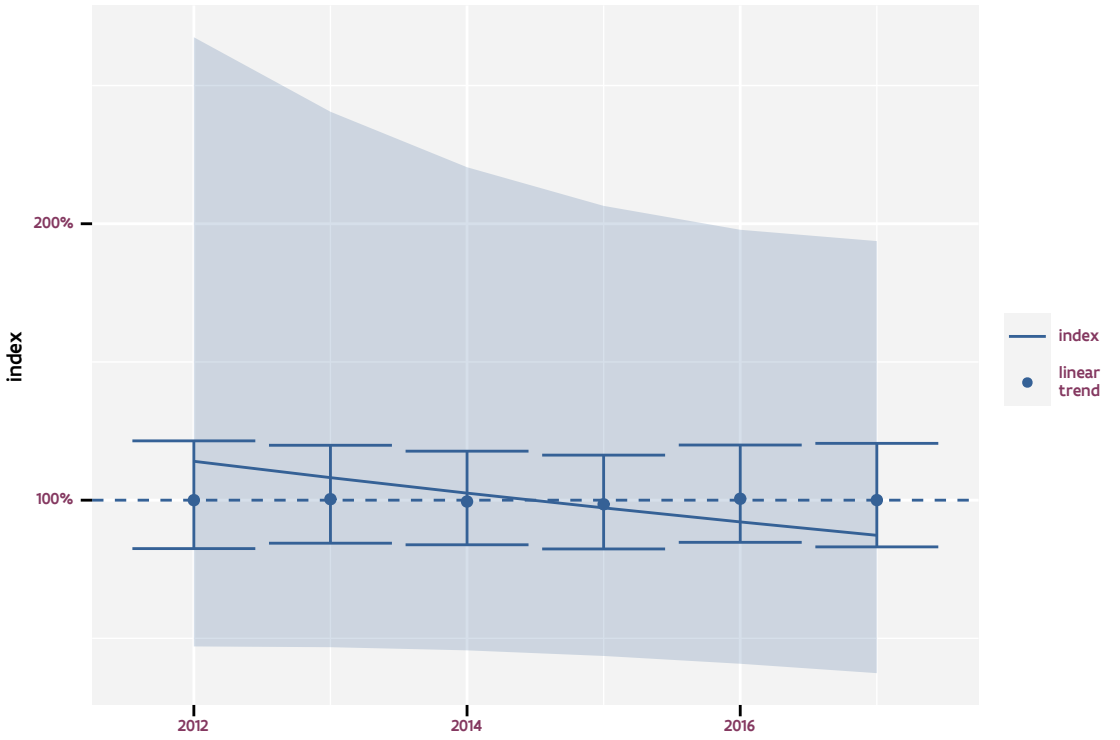

Figure 4.32: Indices and linear trend for *Columba oenas*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

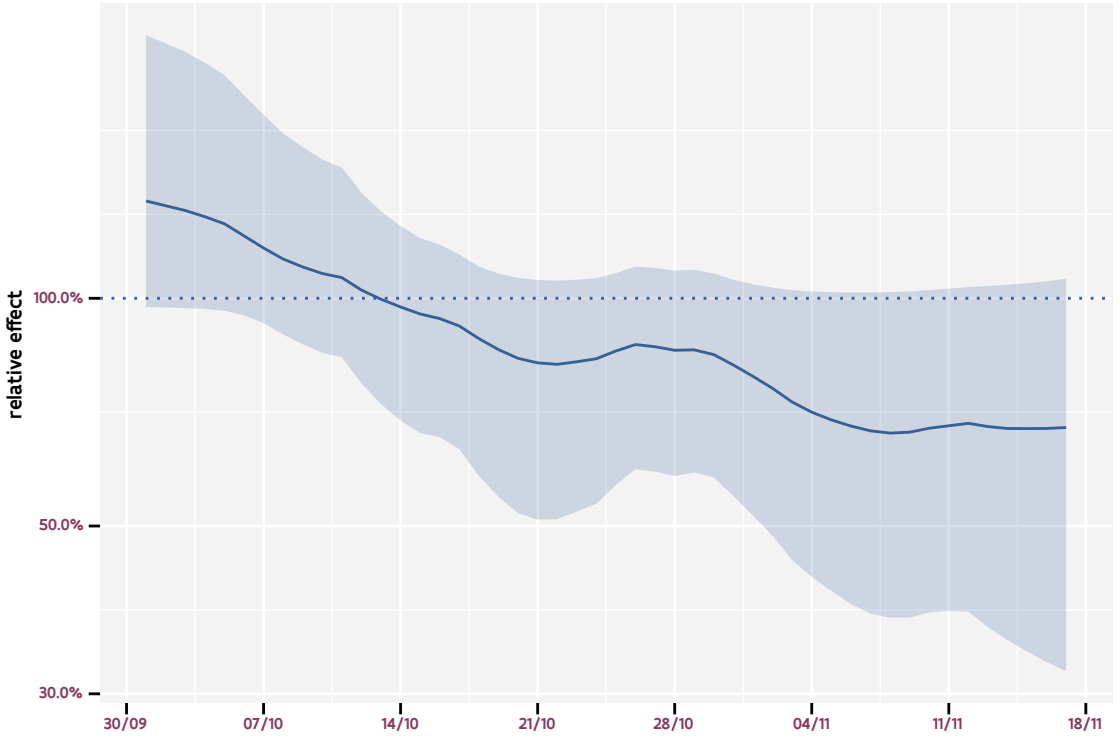

Figure 4.33: Seasonal pattern for *Columba oenas*.

https://doi.org/10.21436/inbor.16917180

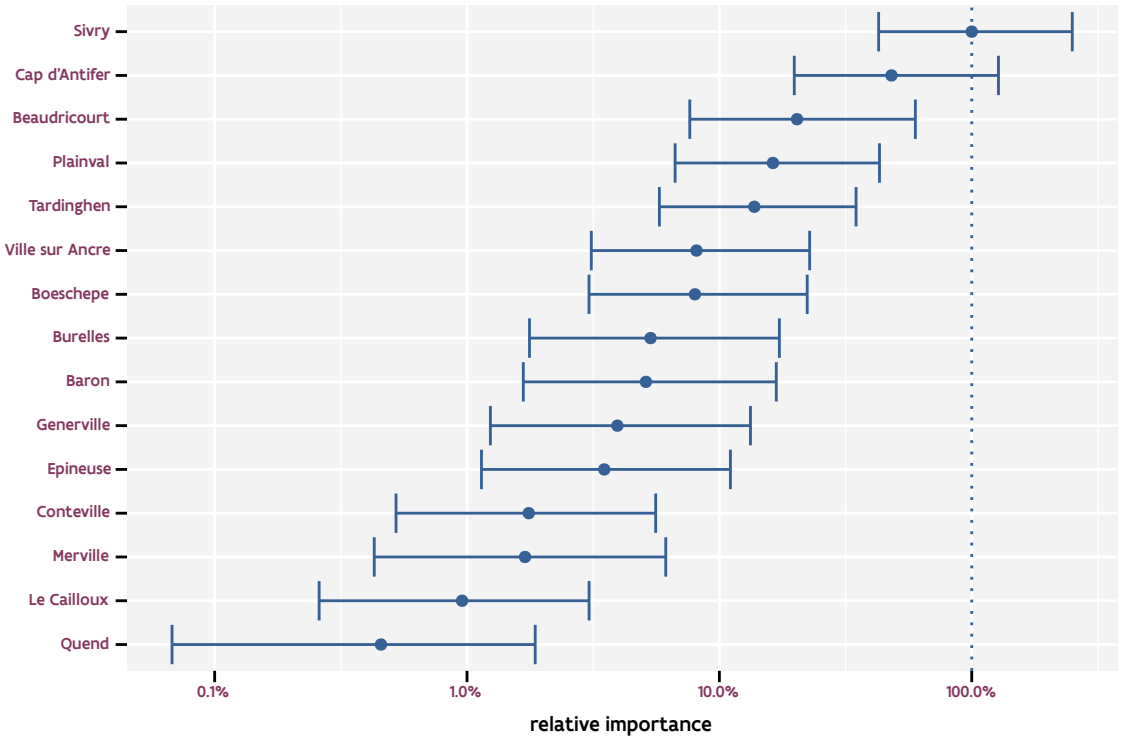

Figure 4.34: Relative importance per site for *Columba oenas*.

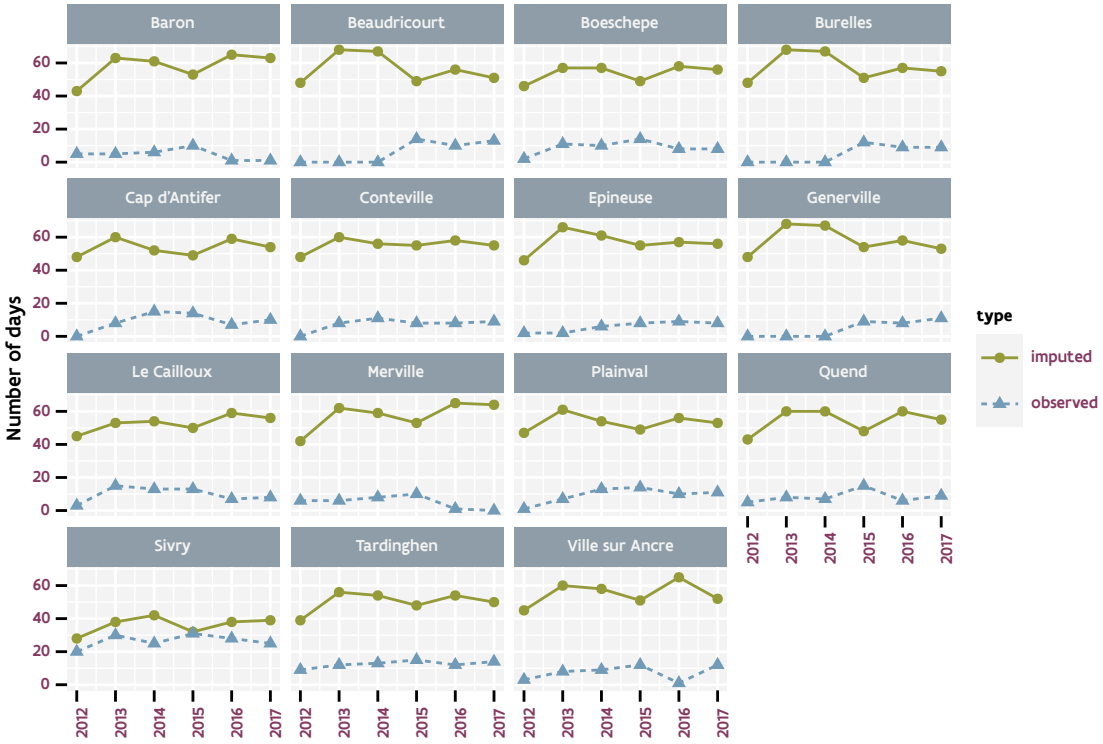

Figure 4.35: Number of days with observations per site and per year for *Columba oenas*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

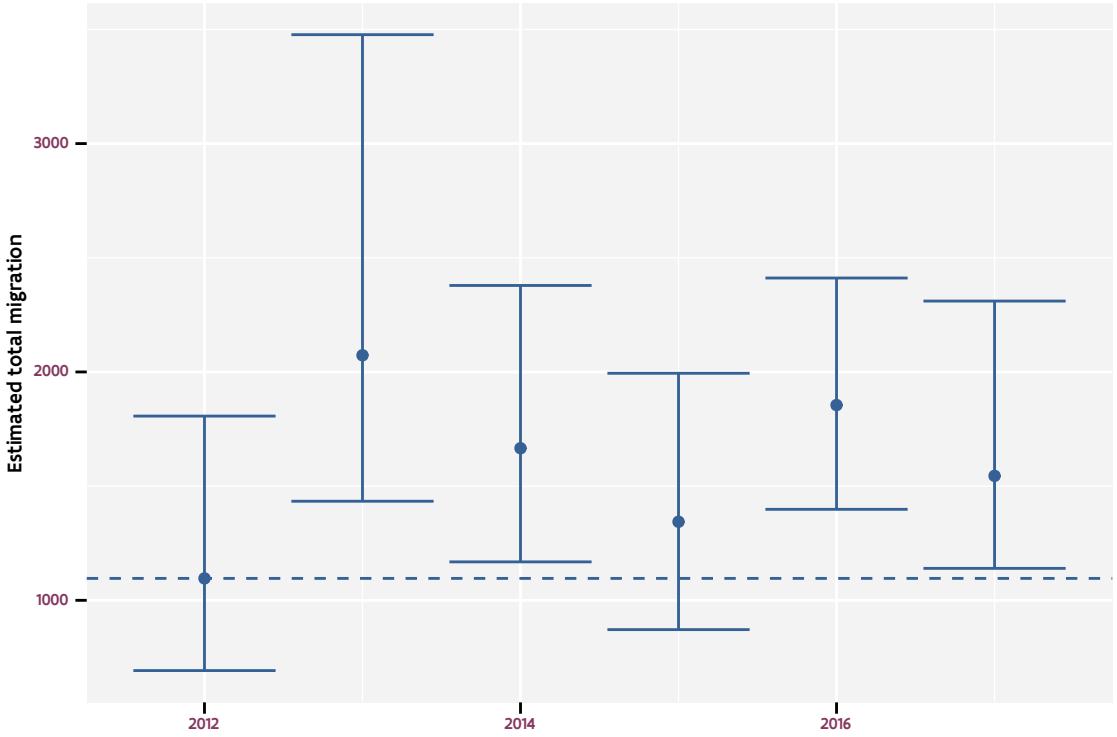

Figure 4.36: Imputed total of *Columba oenas* during the migration period.

4.7 *COLUMBA PALUMBUS*

- English: common wood pigeon
- French: pigeon ramier
- Dutch: houtduif
- EURING: 6700

More information on *Columba palumbus*: https://www.gbif.org/species/2495455

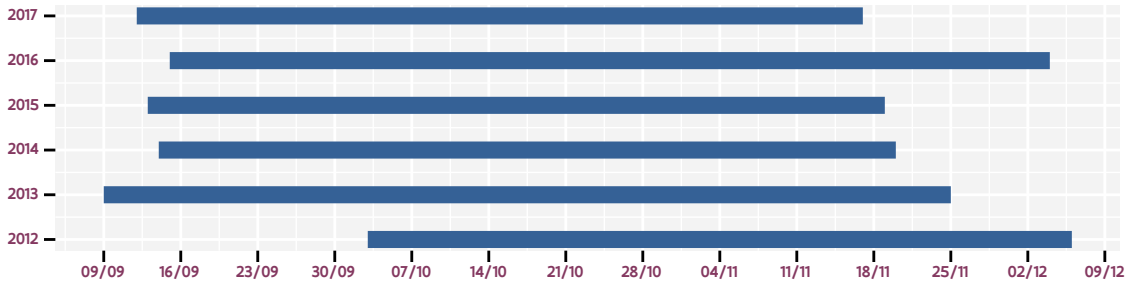

Figure 4.37: Migration periods used for *Columba palumbus*.

https://doi.org/10.21436/inbor.16917180

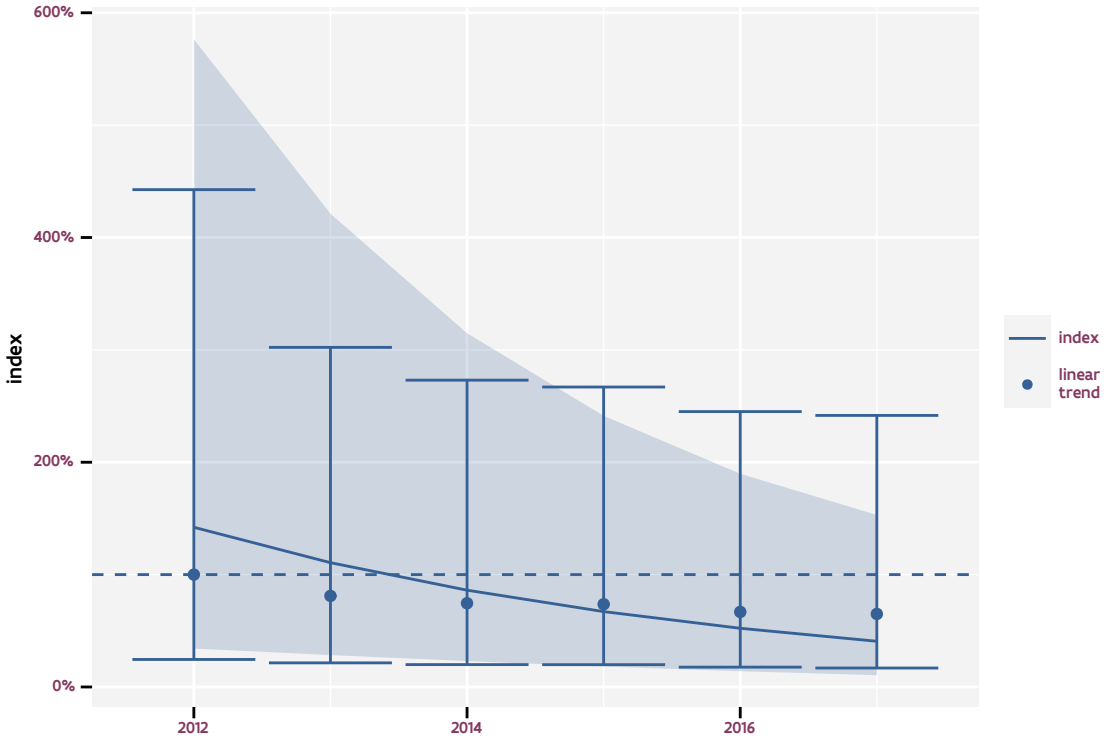

Figure 4.38: Indices and linear trend for *Columba palumbus*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

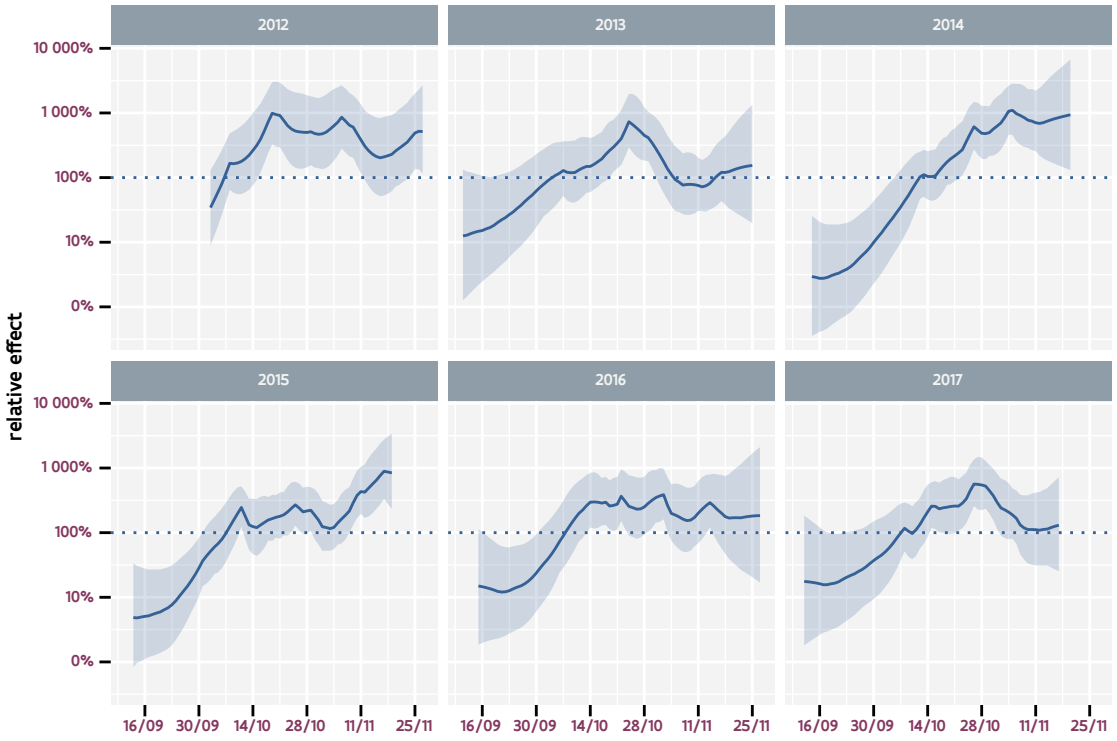

Figure 4.39: Seasonal pattern for *Columba palumbus*.

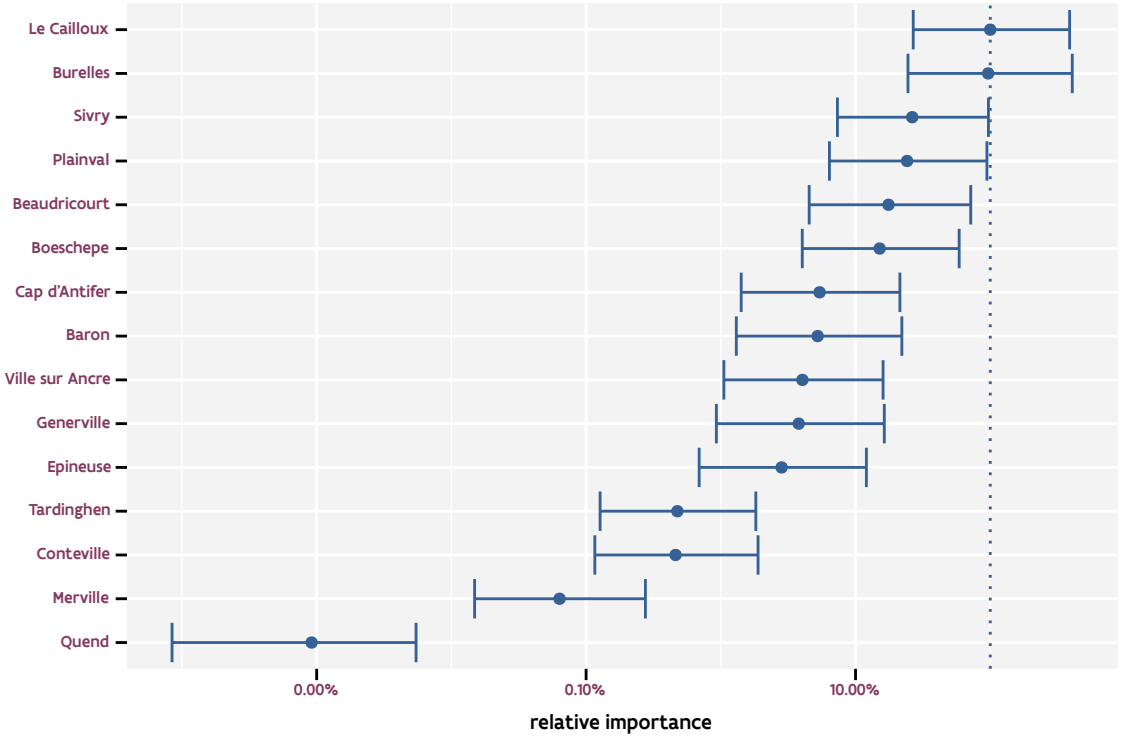

Figure 4.40: Relative importance per site for *Columba palumbus*.

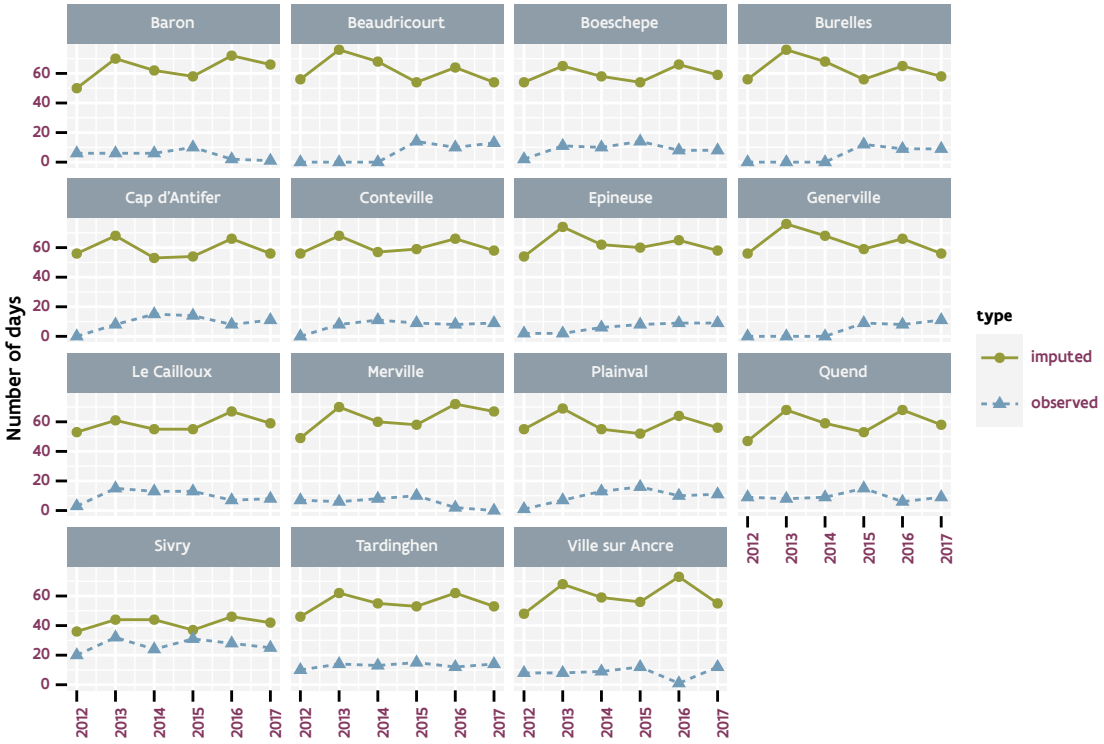

Figure 4.41: Number of days with observations per site and per year for *Columba palumbus*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

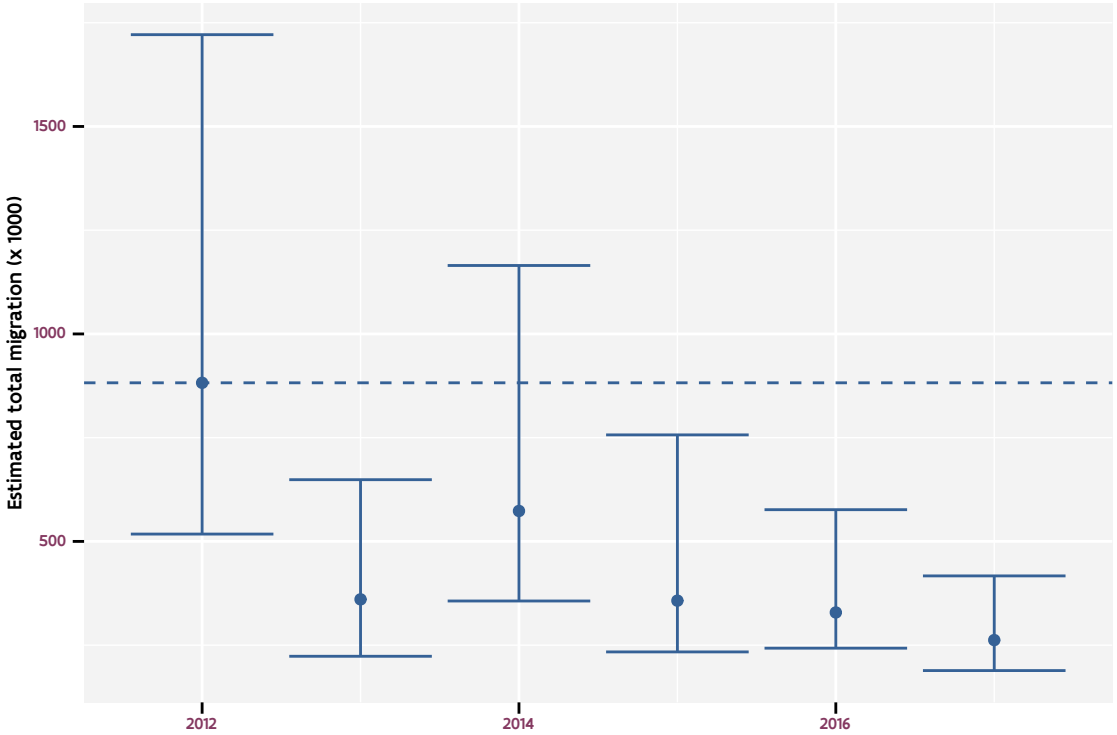

Figure 4.42: Imputed total of *Columba palumbus* during the migration period.

4.8 *LULLULA ARBOREA*

- English: woodlark
- French: alouette lulu
- Dutch: boomleeuwerik
- EURING: 9740

More information on *Lullula arborea*: https://www.gbif.org/species/2490604

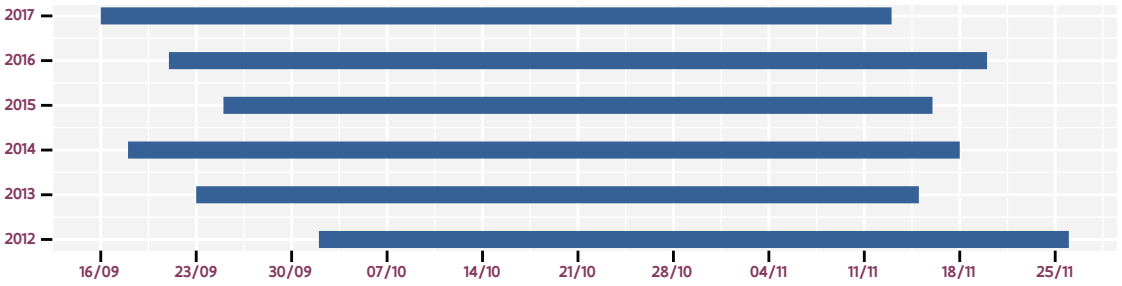

Figure 4.43: Migration periods used for *Lullula arborea*.

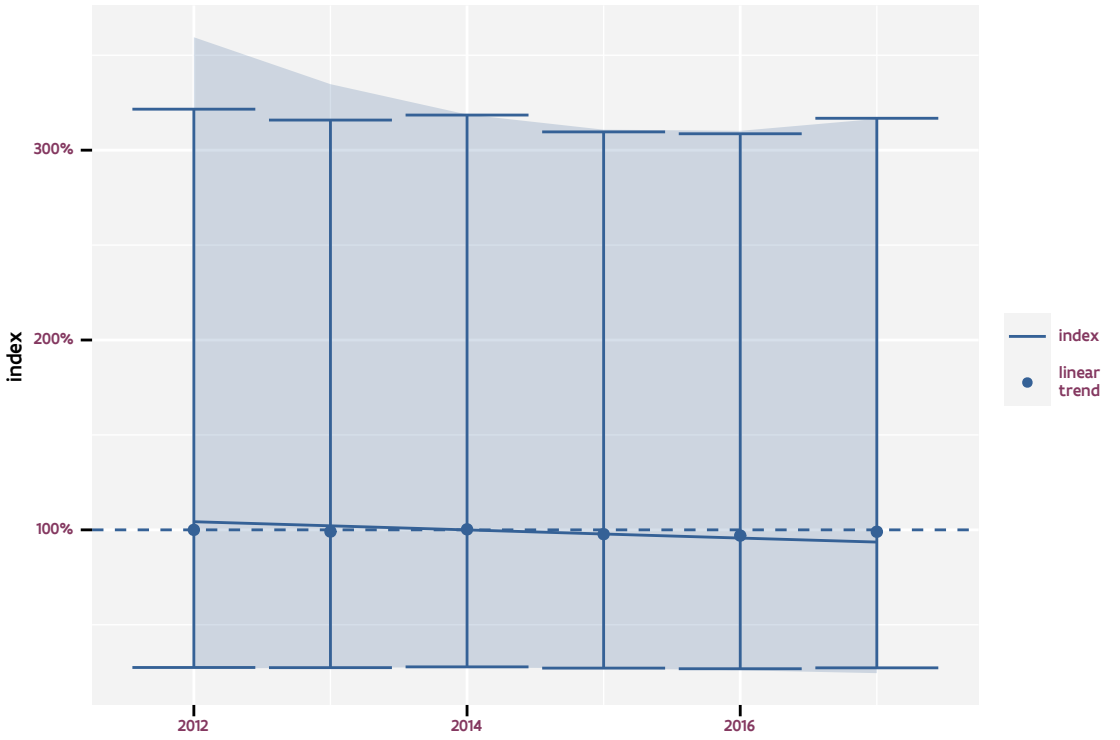

Figure 4.44: Indices and linear trend for *Lullula arborea*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

Figure 4.45: Seasonal pattern for *Lullula arborea*.

https://doi.org/10.21436/inbor.16917180

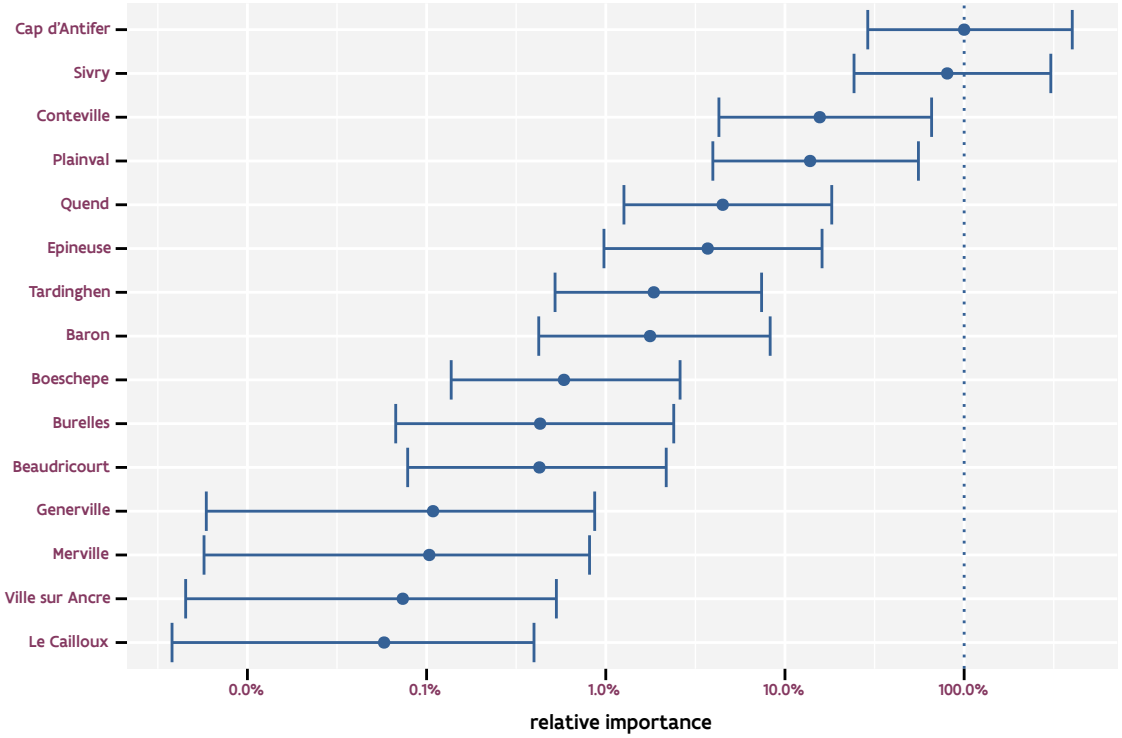

Figure 4.46: Relative importance per site for *Lullula arborea*.

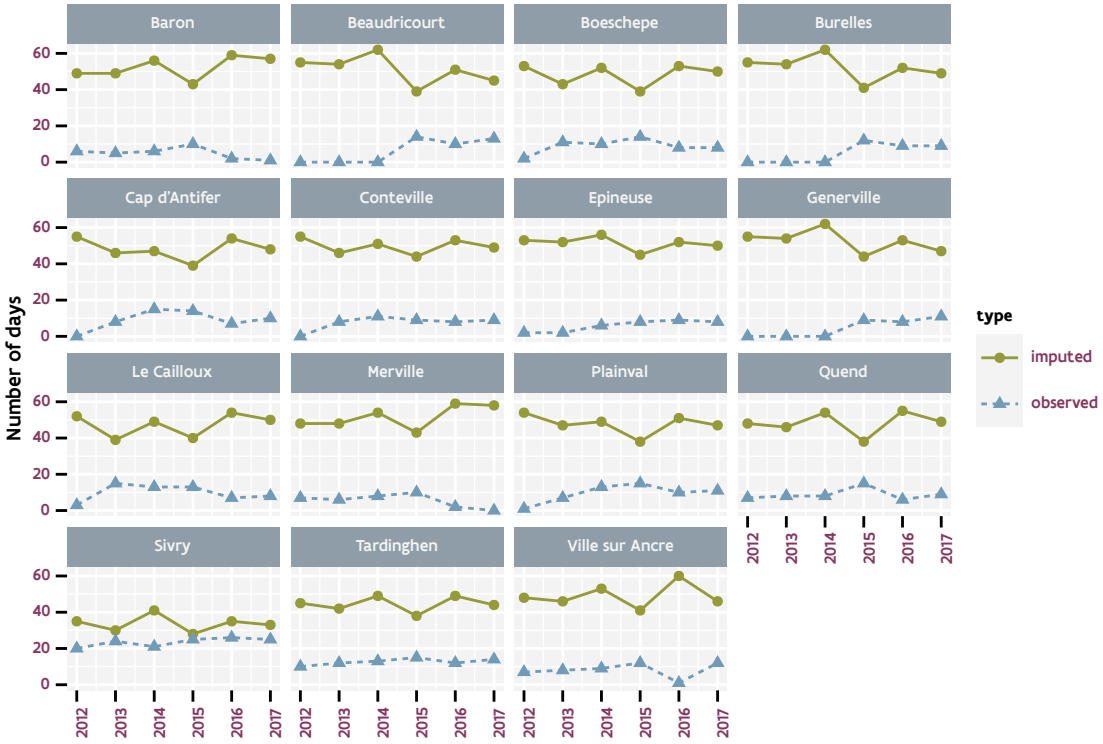

Figure 4.47: Number of days with observations per site and per year for *Lullula arborea*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

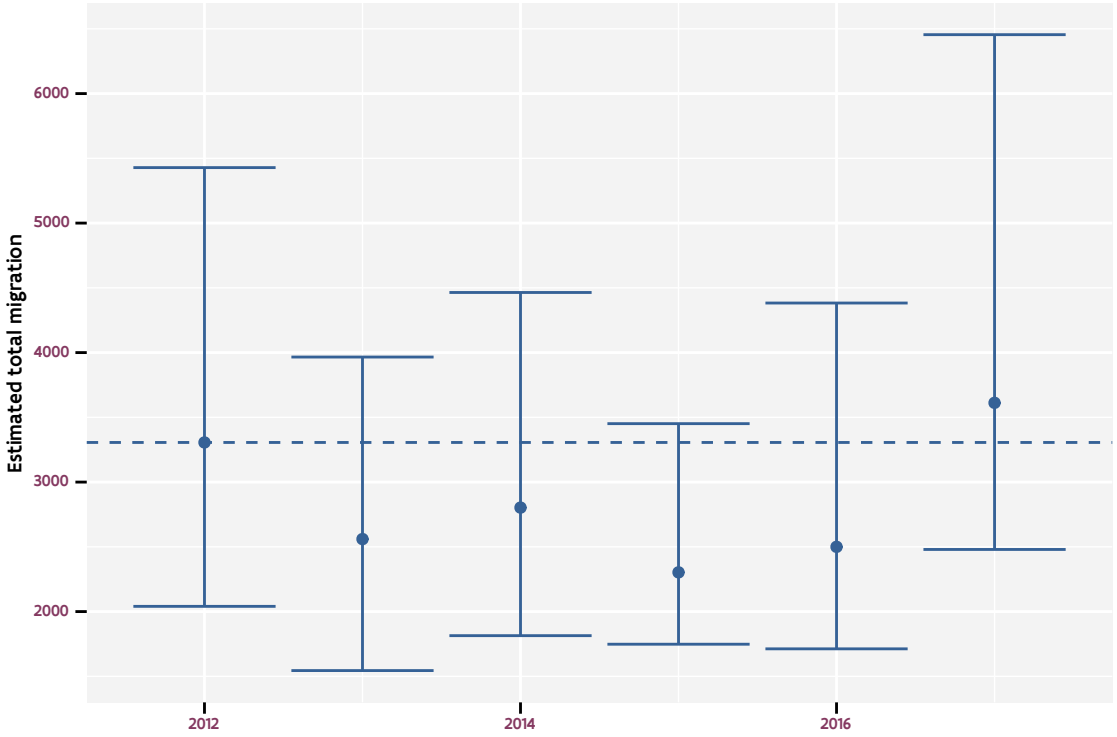

Figure 4.48: Imputed total of *Lullula arborea* during the migration period.

4.9 *ALAUDA ARVENSIS*

- English: skylark
- French: alouette des champs
- Dutch: veldleeuwerik
- EURING: 9760

More information on *Alauda arvensis*: https://www.gbif.org/species/8077224

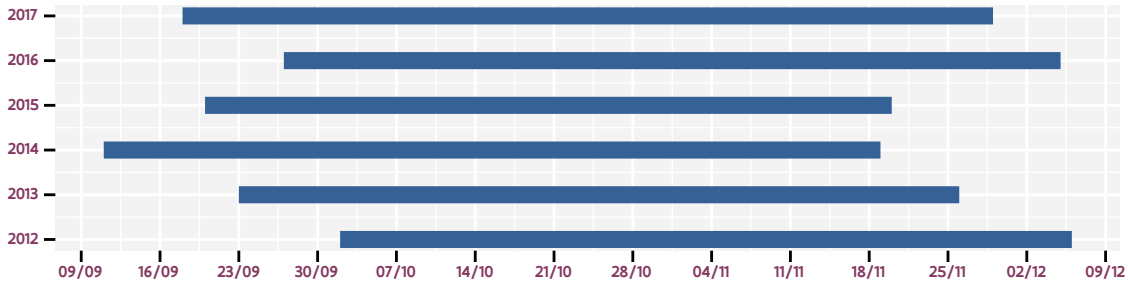

Figure 4.49: Migration periods used for *Alauda arvensis*.

https://doi.org/10.21436/inbor.16917180

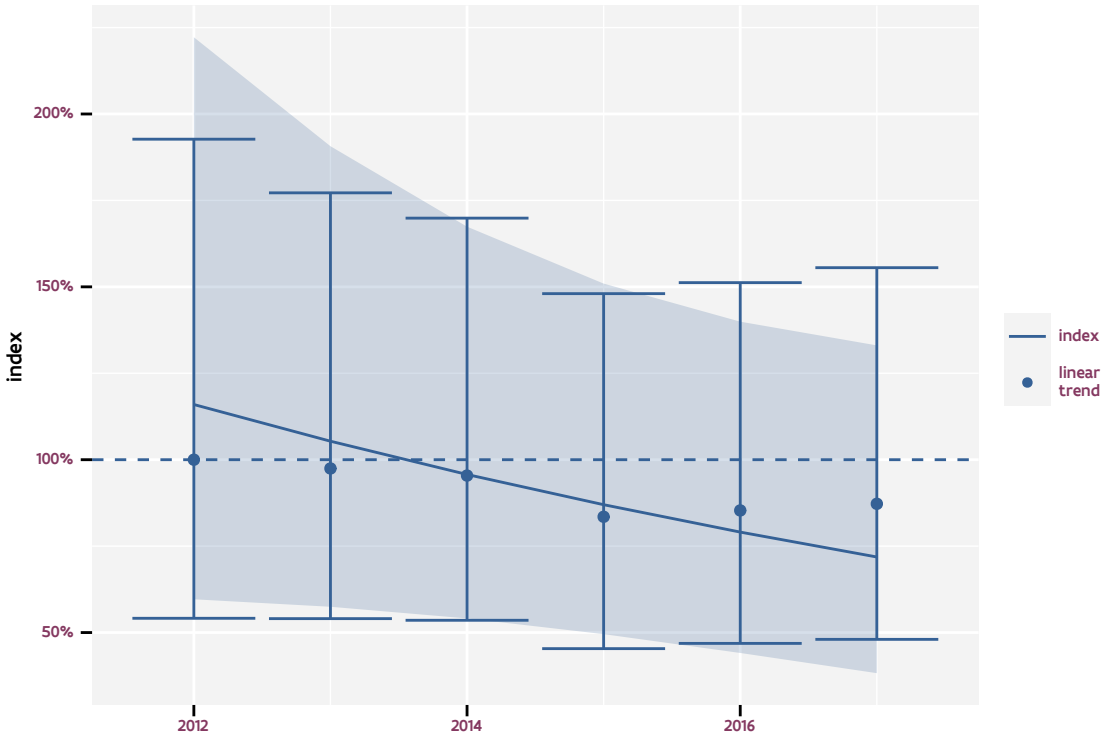

Figure 4.50: Indices and linear trend for *Alauda arvensis*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

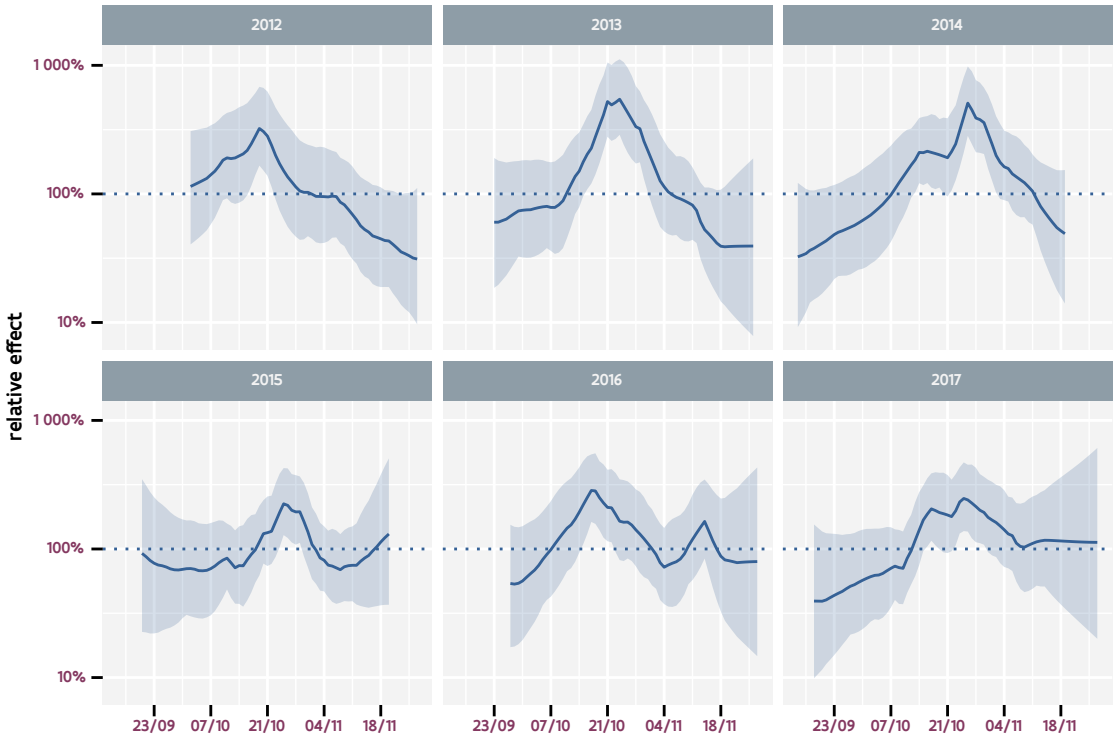

Figure 4.51: Seasonal pattern for *Alauda arvensis*.

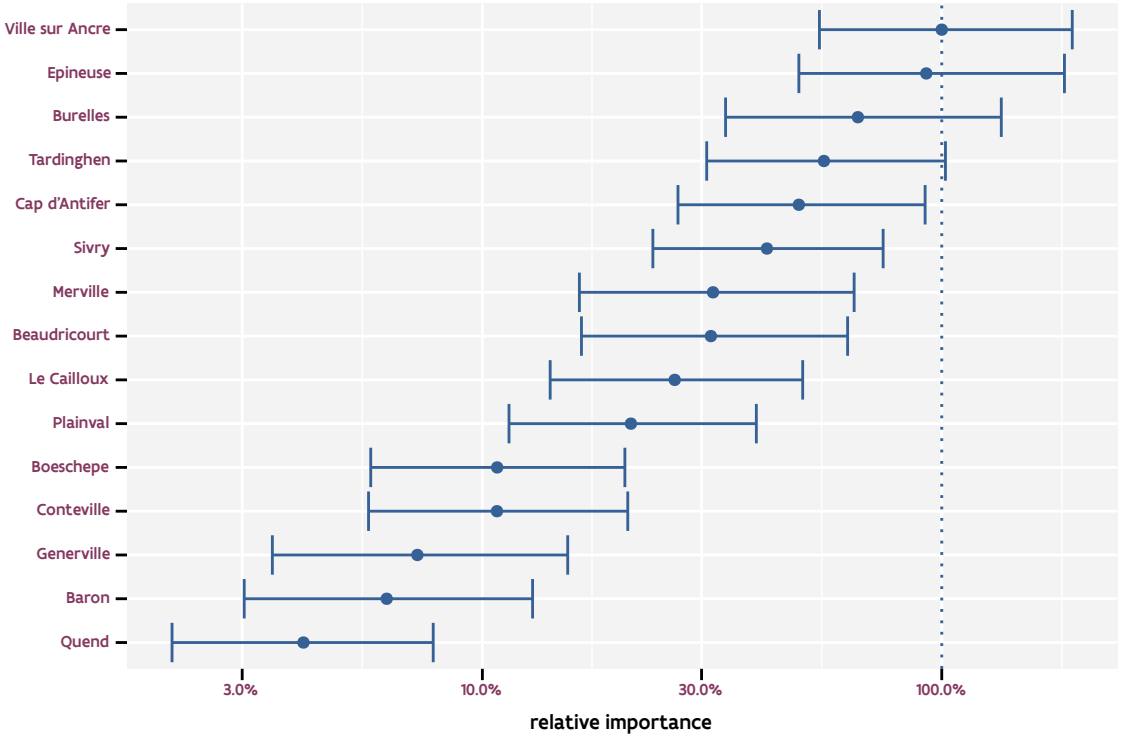

Figure 4.52: Relative importance per site for *Alauda arvensis*.

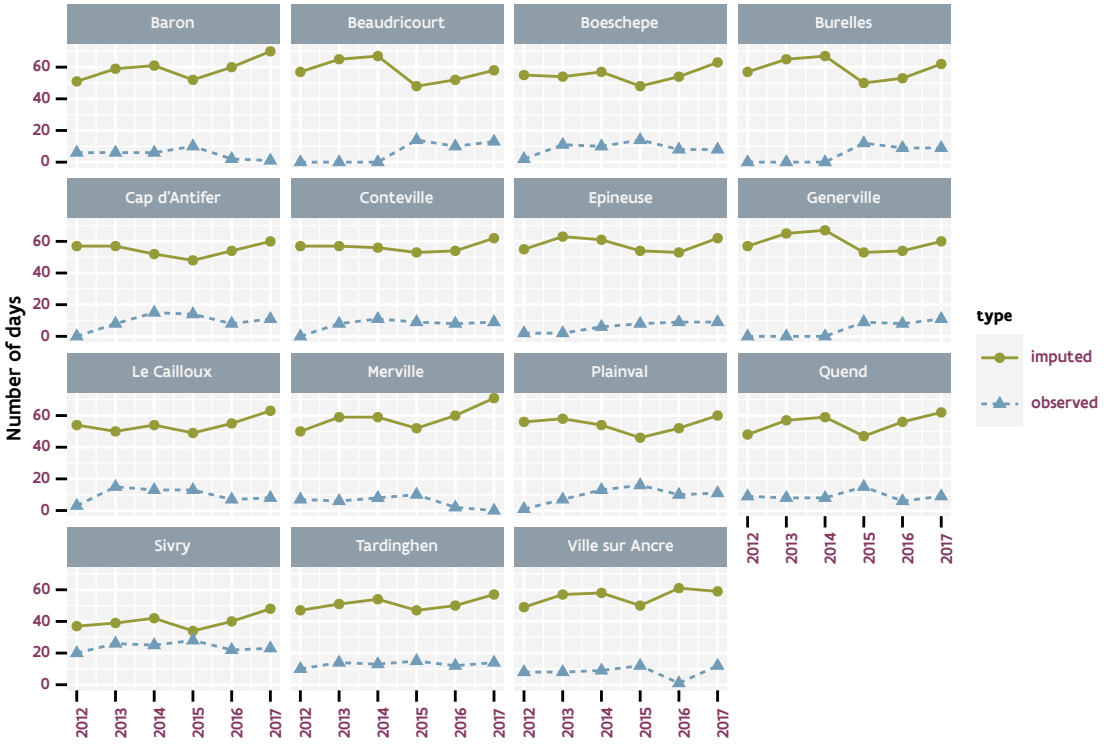

Figure 4.53: Number of days with observations per site and per year for *Alauda arvensis*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

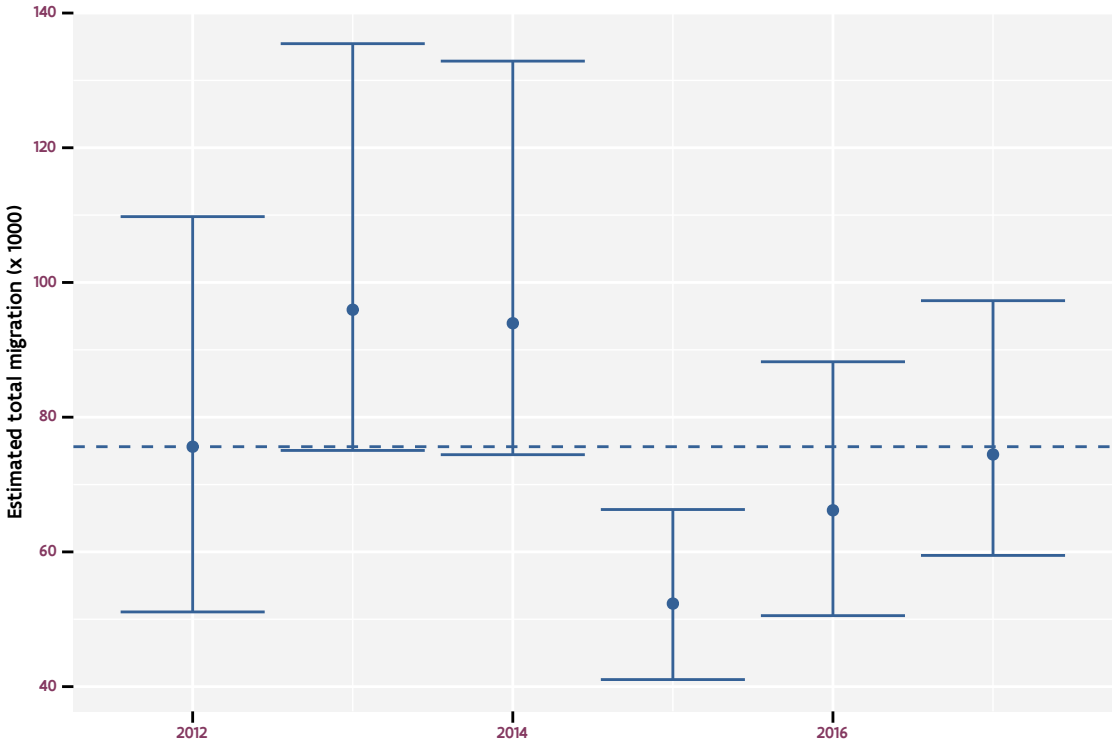

Figure 4.54: Imputed total of *Alauda arvensis* during the migration period.

4.10 *HIRUNDO RUSTICA*

- English: barn swallow
- French: hirondelle de cheminée
- Dutch: boerenzwaluw
- EURING: 9920

More information on *Hirundo rustica*: https://www.gbif.org/species/9515886

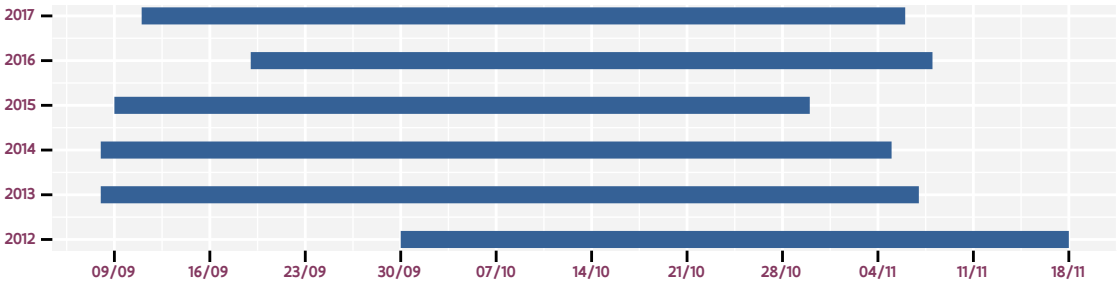

Figure 4.55: Migration periods used for *Hirundo rustica*.

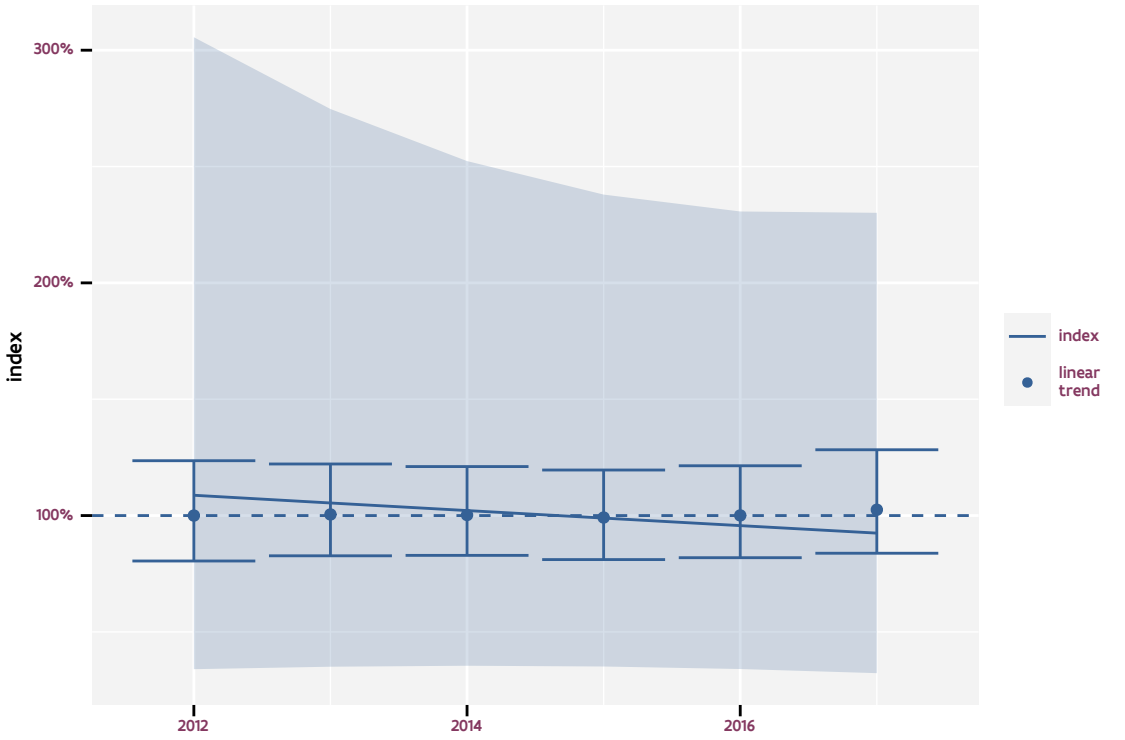

Figure 4.56: Indices and linear trend for *Hirundo rustica*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

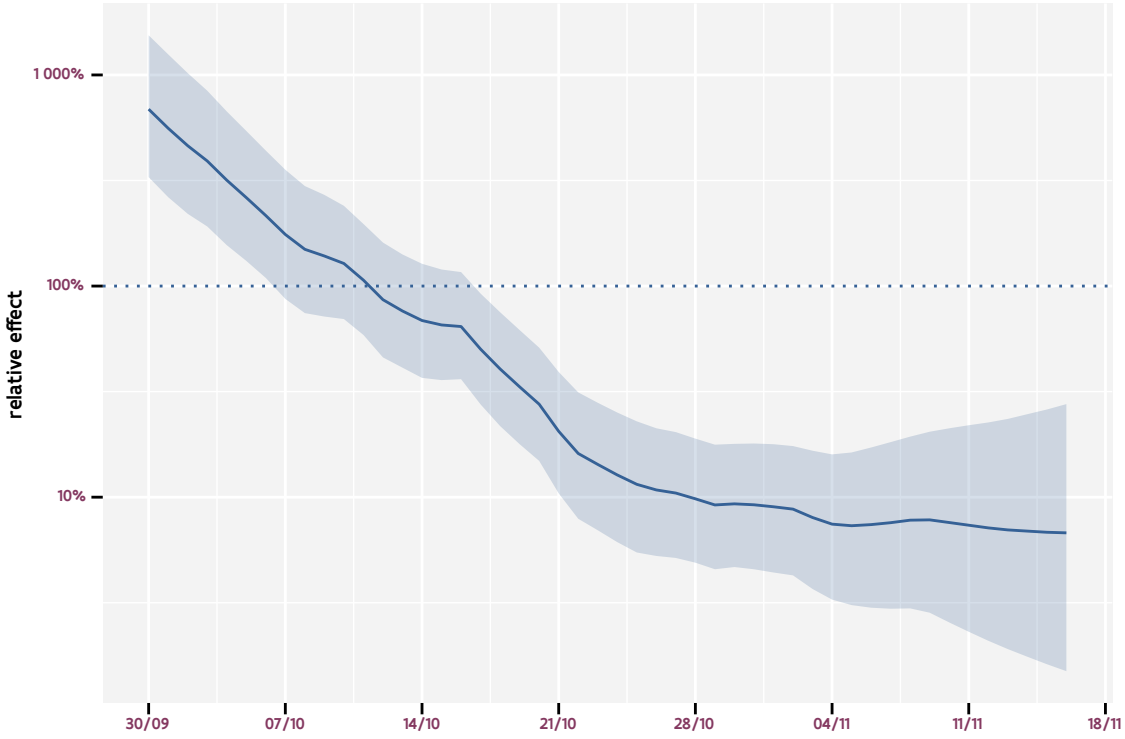

Figure 4.57: Seasonal pattern for *Hirundo rustica*.

https://doi.org/10.21436/inbor.16917180

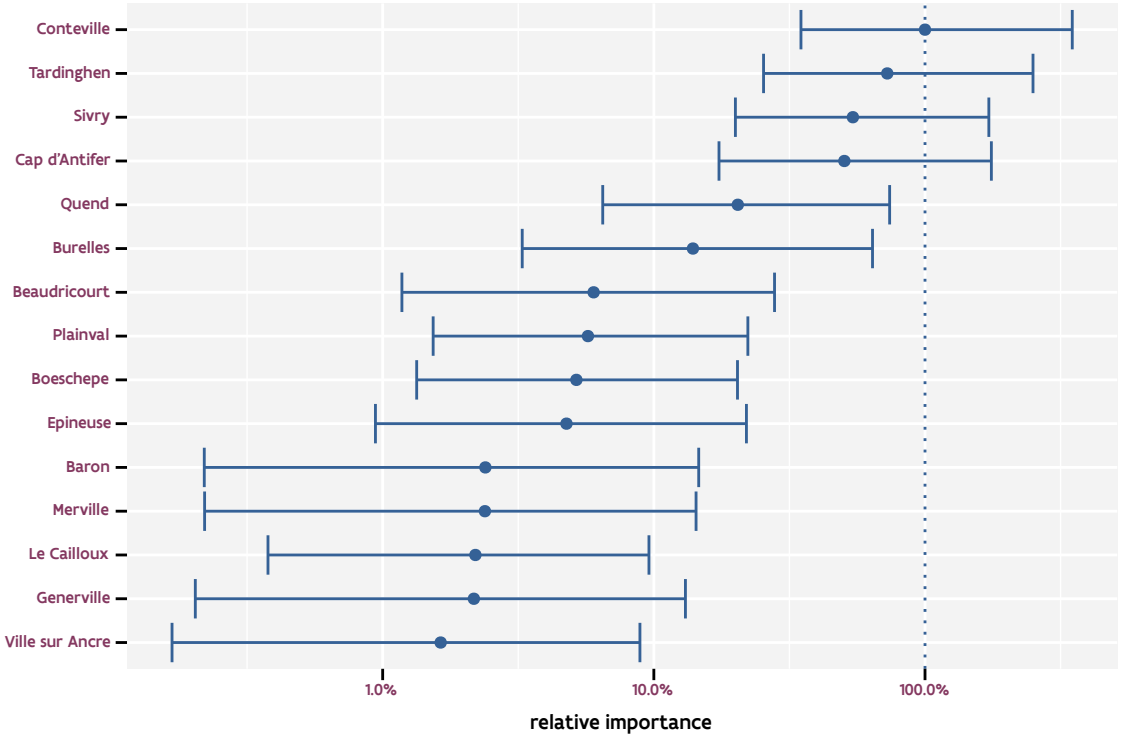

Figure 4.58: Relative importance per site for *Hirundo rustica*.

Figure 4.59: Number of days with observations per site and per year for *Hirundo rustica*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

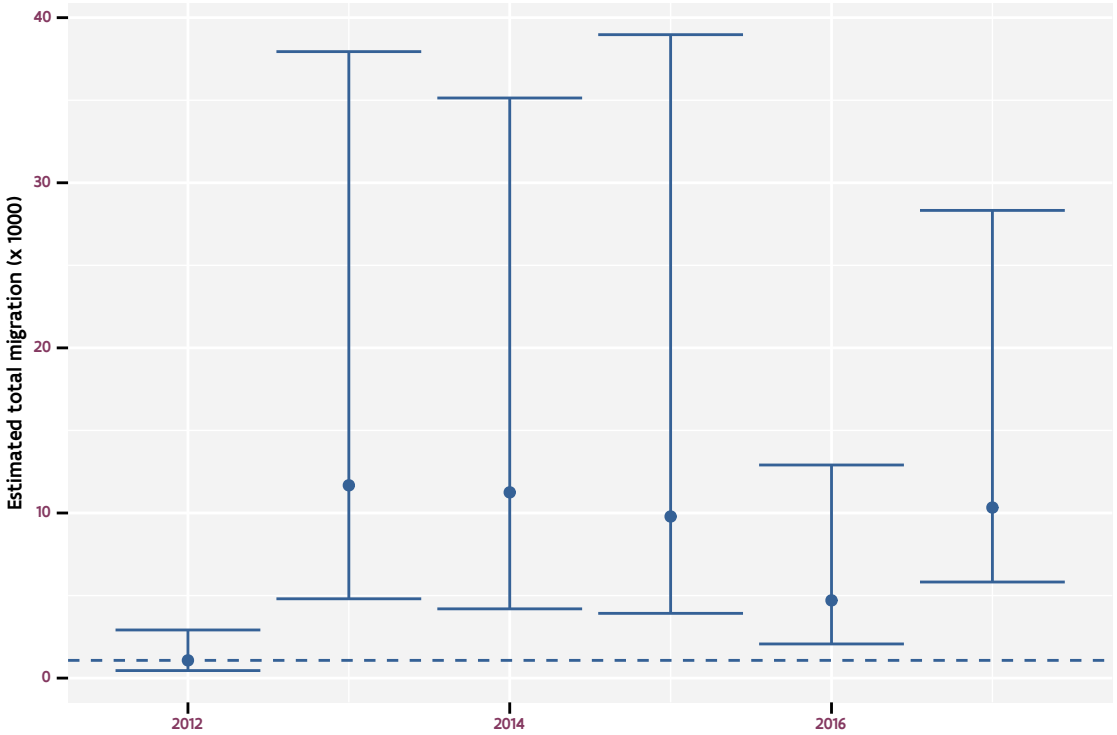

Figure 4.60: Imputed total of *Hirundo rustica* during the migration period.

4.11 *ANTHUS PRATENSIS*

- English: meadow pipit
- French: pipit farlouse
- Dutch: graspieper
- EURING: 10110

More information on *Anthus pratensis*: https://www.gbif.org/species/2490266

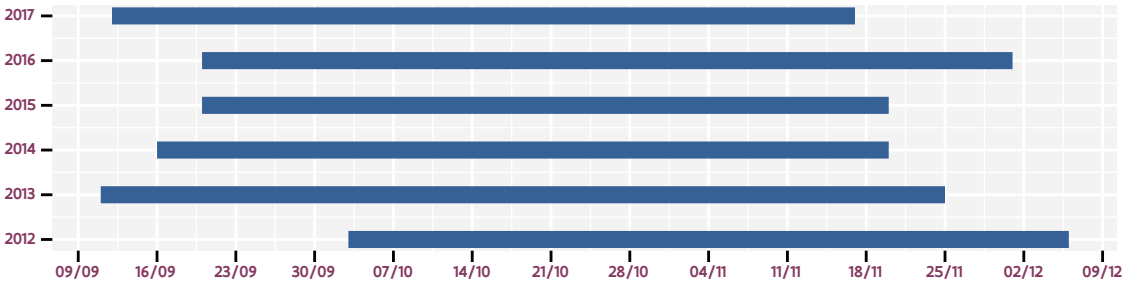

Figure 4.61: Migration periods used for *Anthus pratensis*.

https://doi.org/10.21436/inbor.16917180

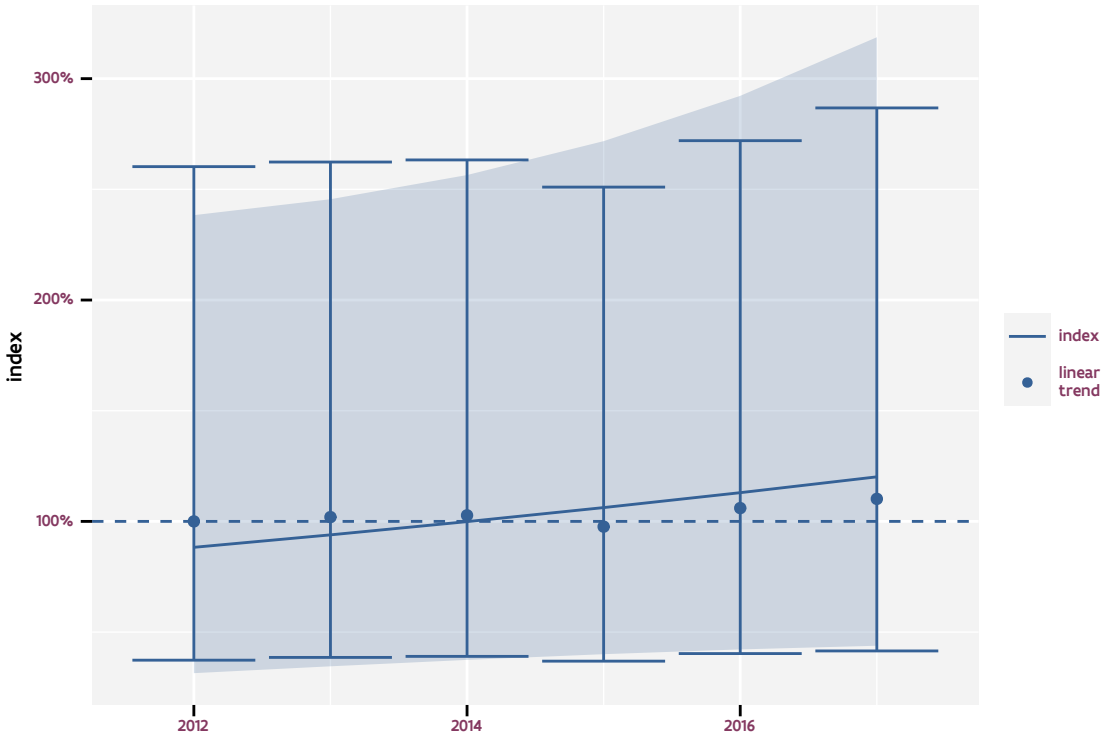

Figure 4.62: Indices and linear trend for *Anthus pratensis*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

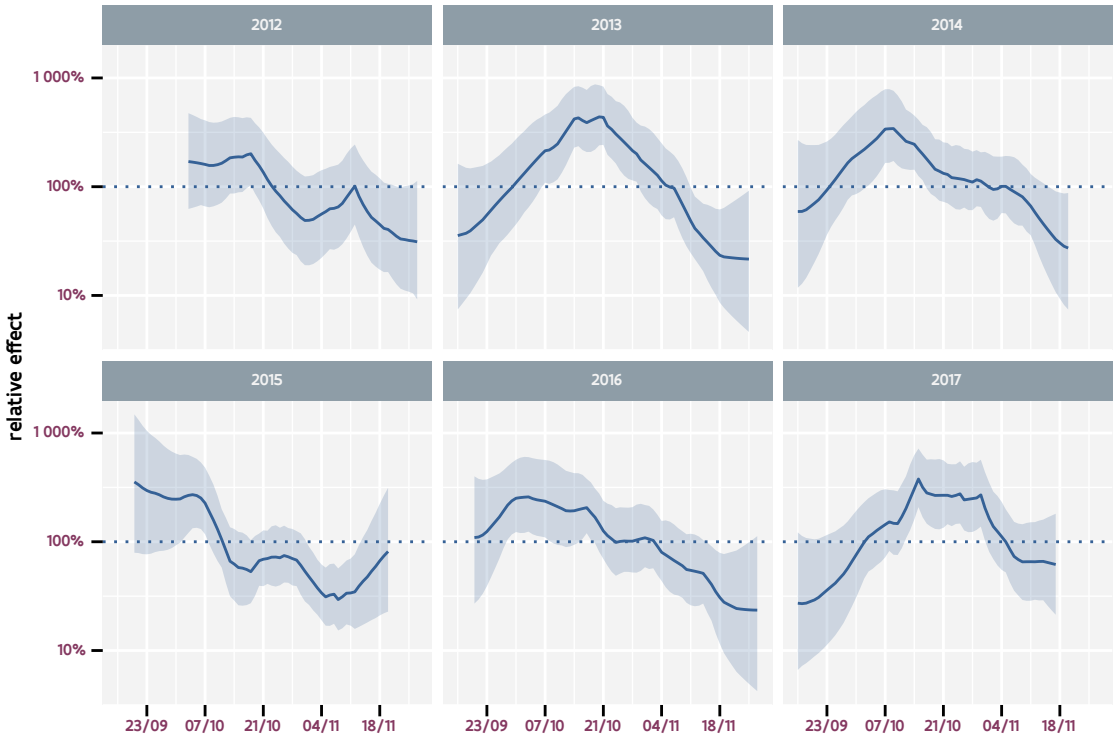

Figure 4.63: Seasonal pattern for *Anthus pratensis*.

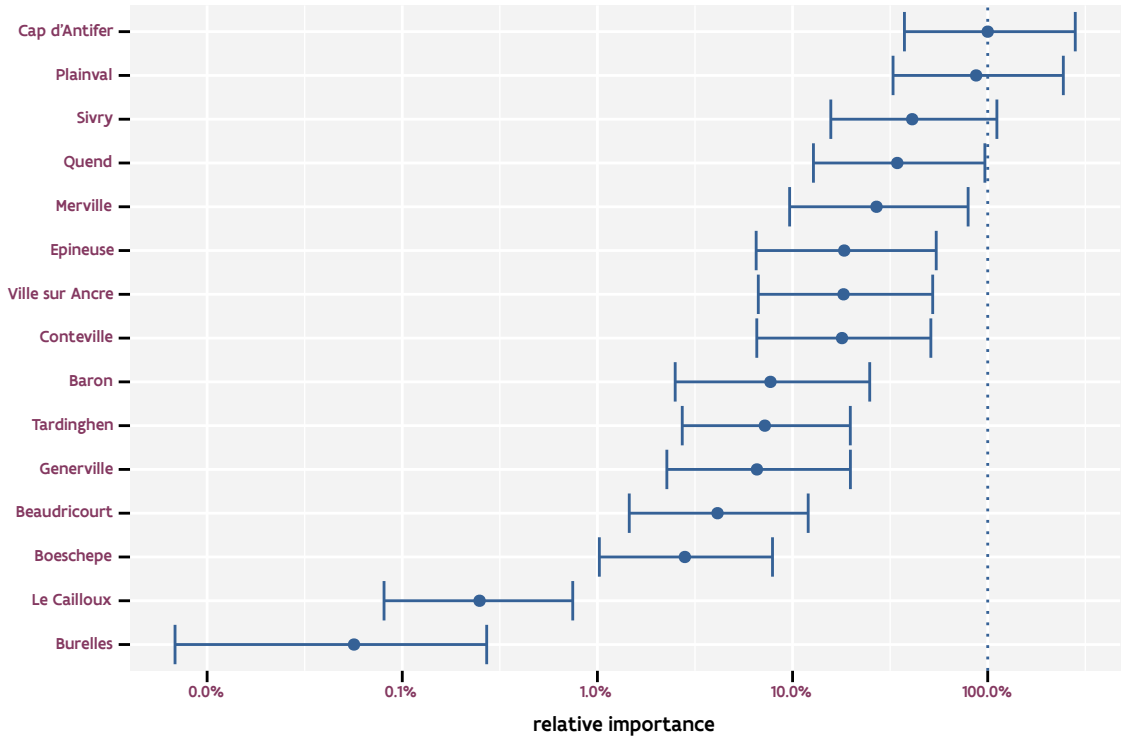

Figure 4.64: Relative importance per site for *Anthus pratensis*.

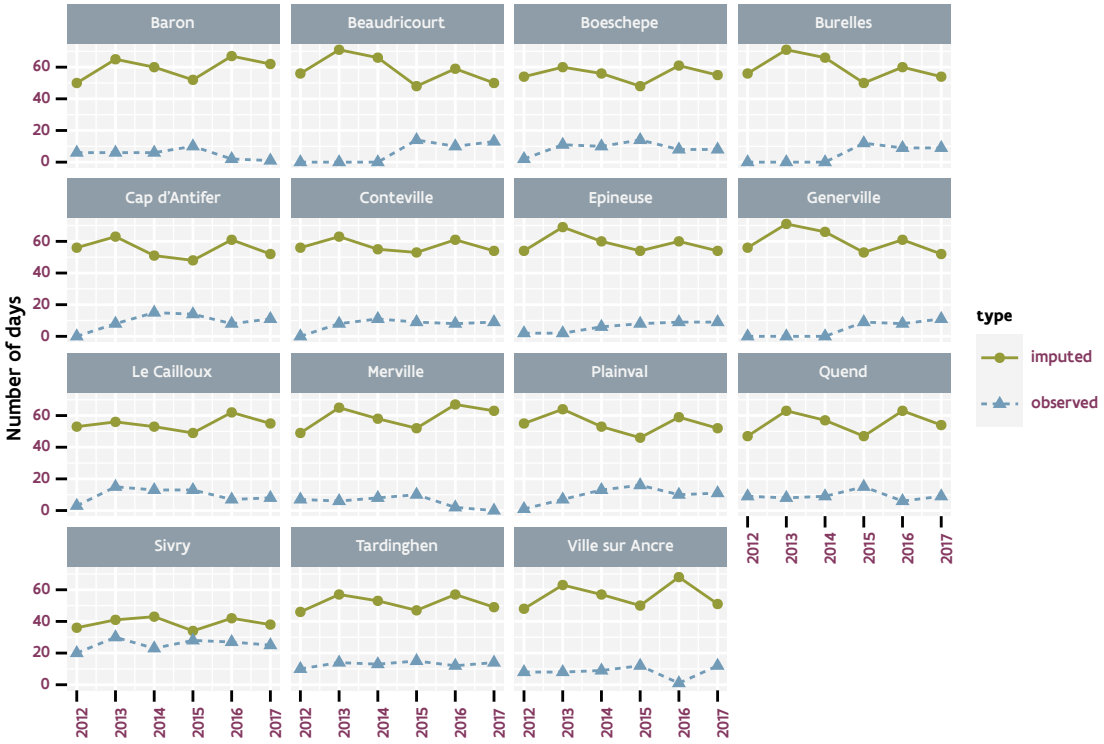

Figure 4.65: Number of days with observations per site and per year for *Anthus pratensis*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

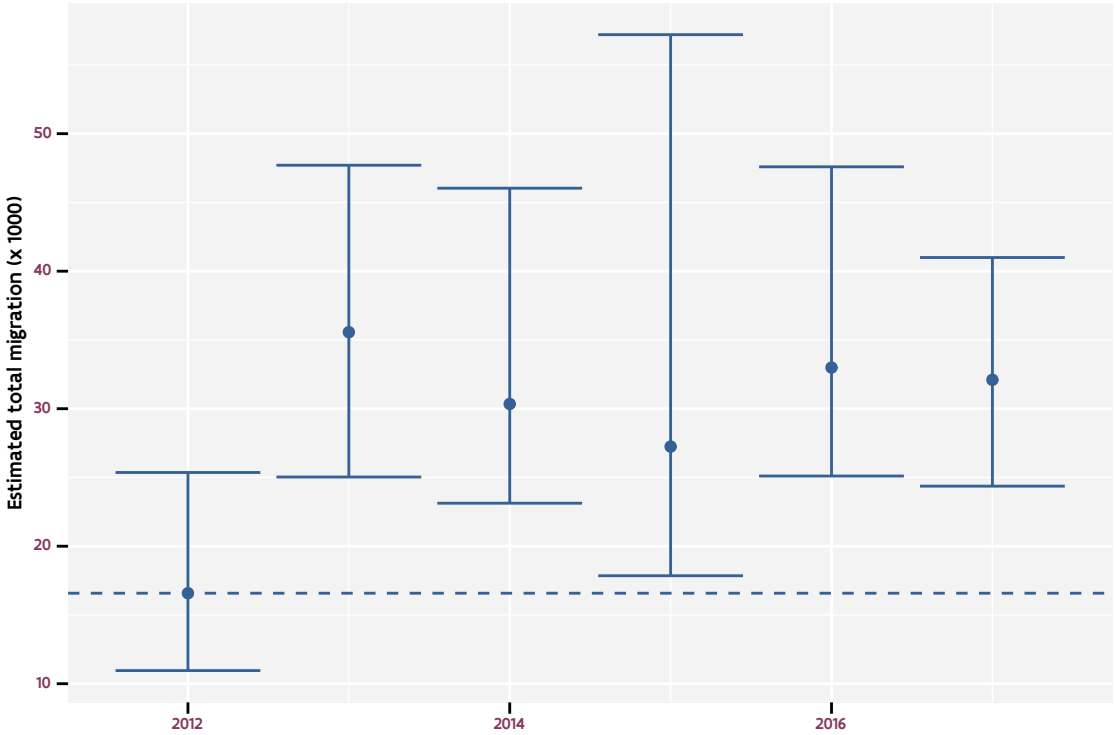

Figure 4.66: Imputed total of *Anthus pratensis* during the migration period.

4.12 *MOTACILLA ALBA*

- English: white wagtail
- French: bergeronnette grise
- Dutch: witte kwikstaart
- EURING: 10200

More information on *Motacilla alba*: https://www.gbif.org/species/9687165

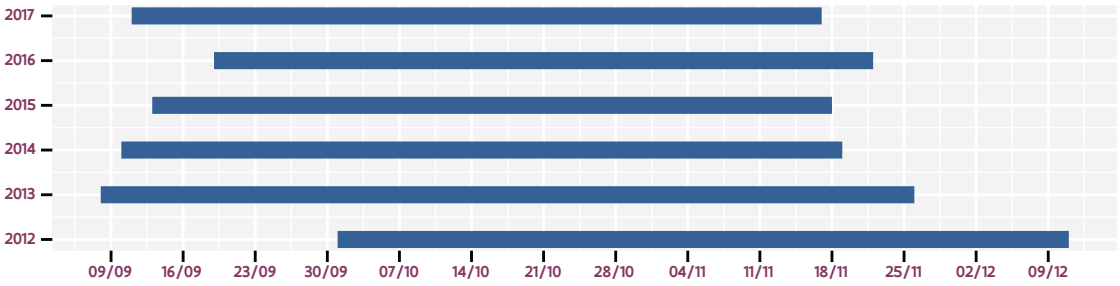

Figure 4.67: Migration periods used for *Motacilla alba*.

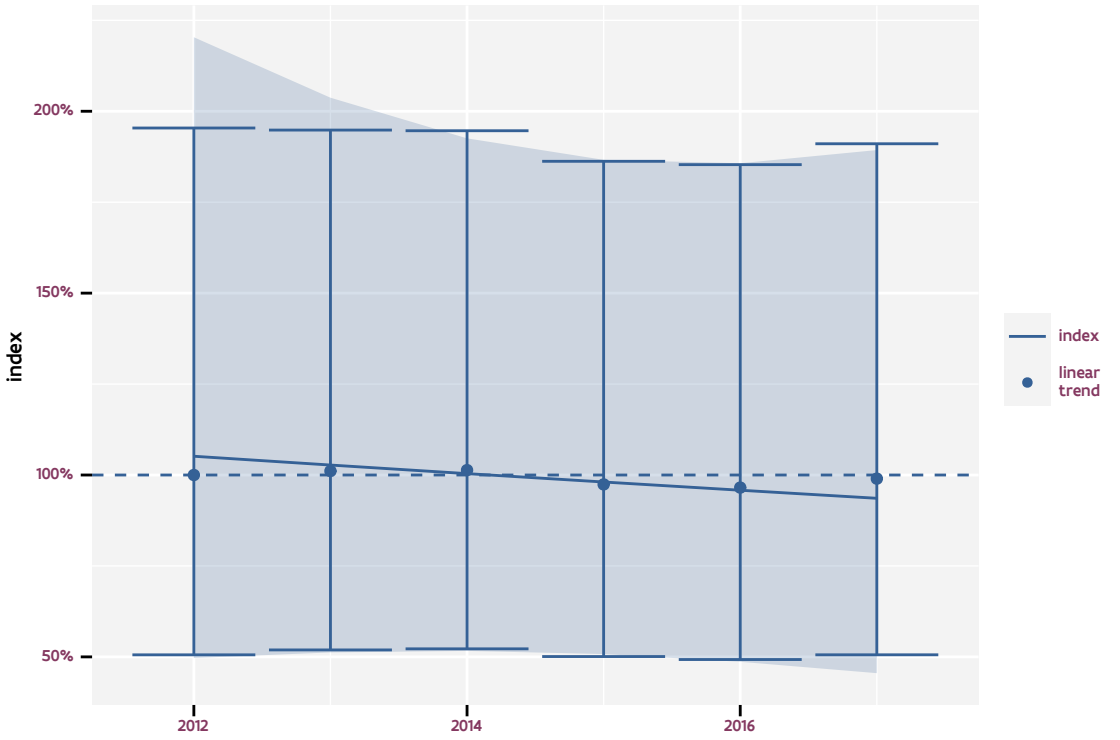

Figure 4.68: Indices and linear trend for *Motacilla alba*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

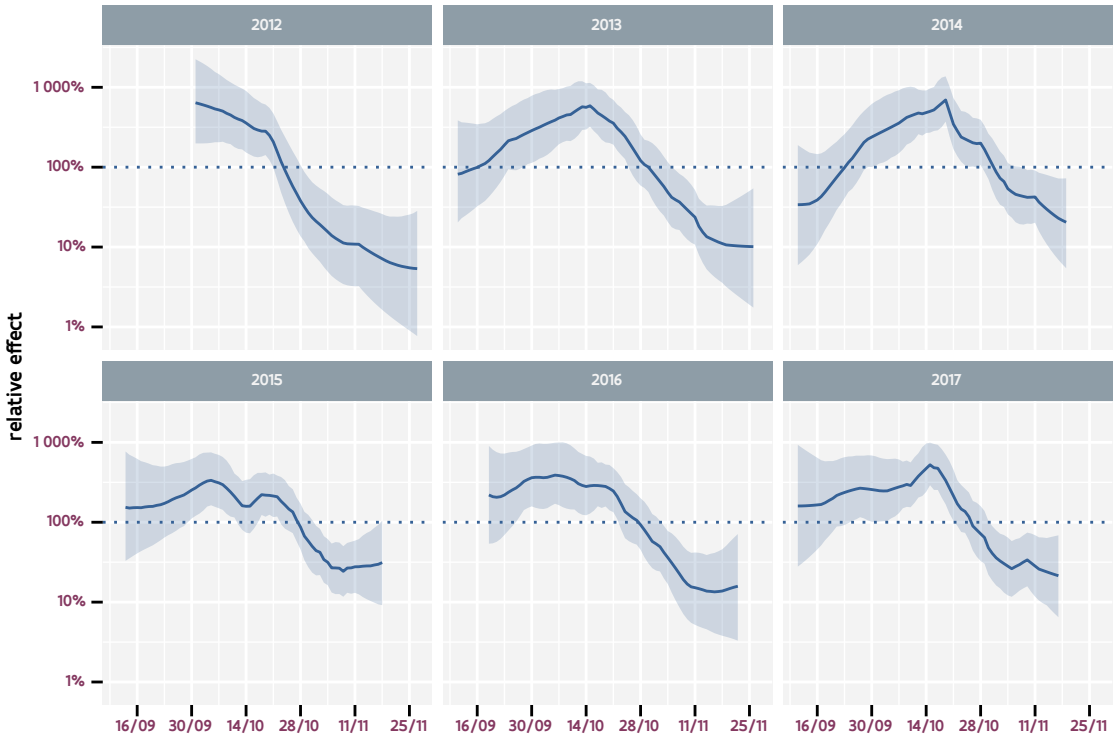

Figure 4.69: Seasonal pattern for *Motacilla alba*.

https://doi.org/10.21436/inbor.16917180

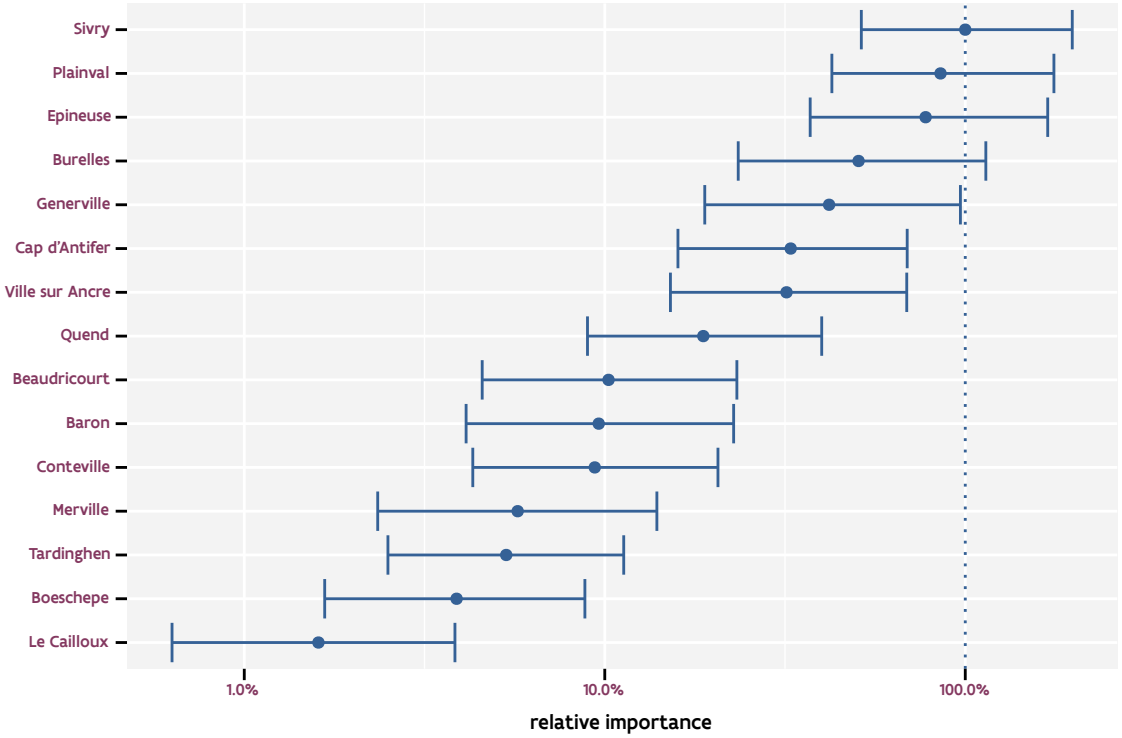

Figure 4.70: Relative importance per site for *Motacilla alba*.

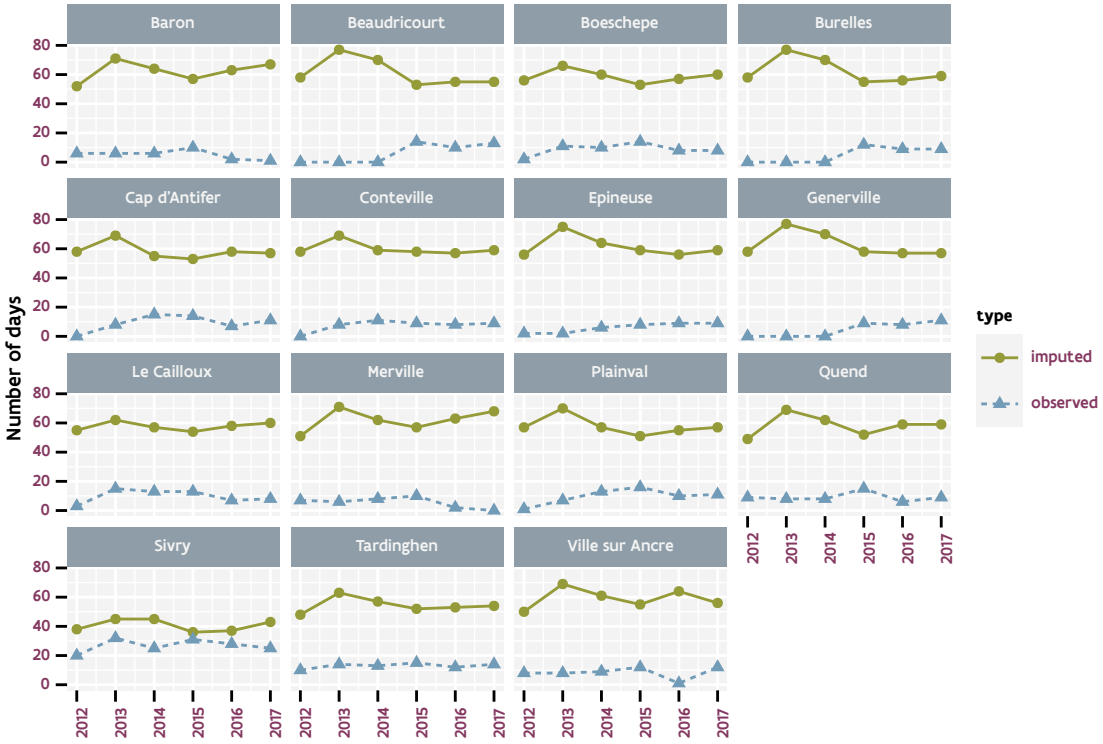

Figure 4.71: Number of days with observations per site and per year for *Motacilla alba*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

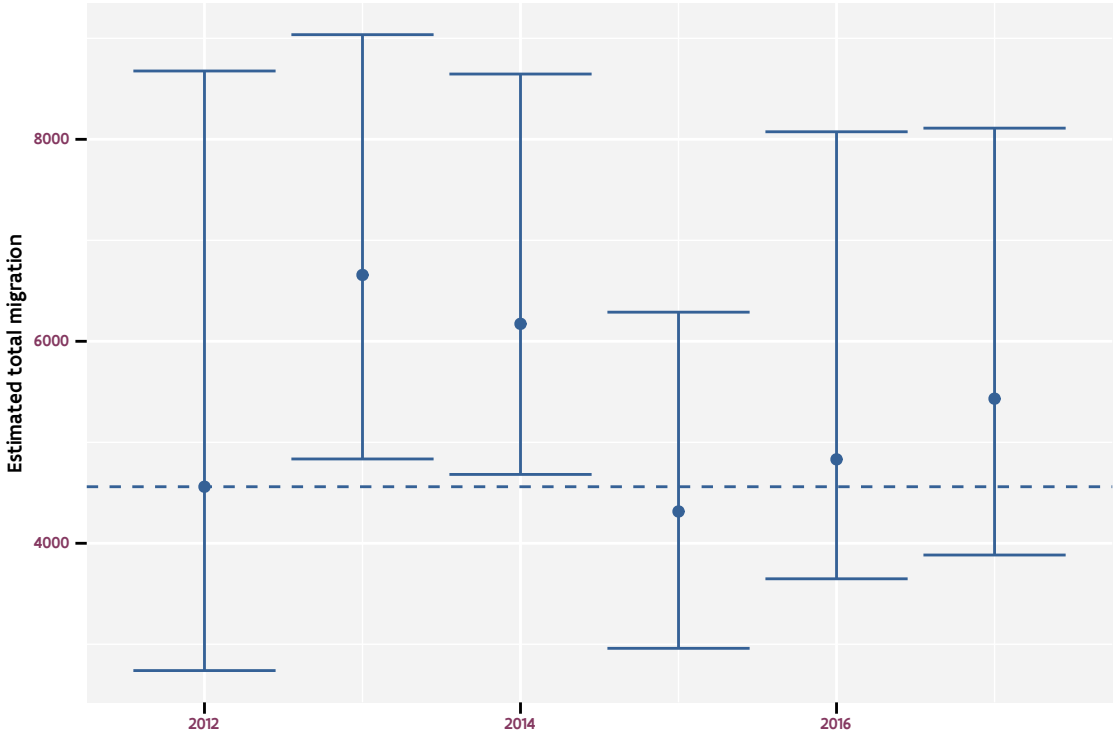

Figure 4.72: Imputed total of *Motacilla alba* during the migration period.

4.13 *TURDUS MERULA*

- English: blackbird
- French: merle noir
- Dutch: merel
- EURING: 11870

More information on *Turdus merula*: https://www.gbif.org/species/2490719

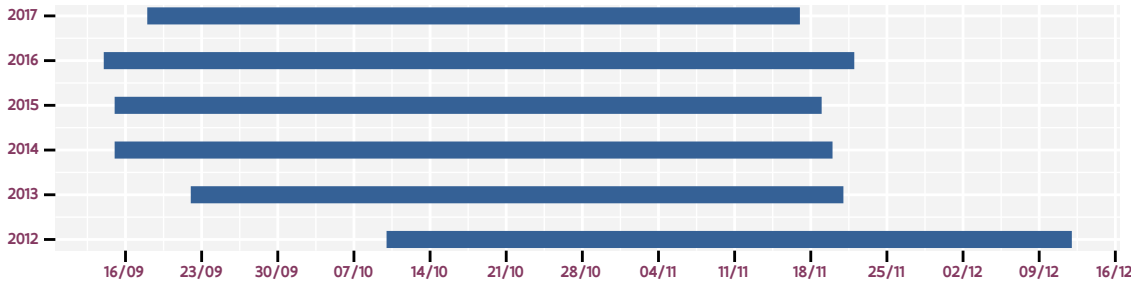

Figure 4.73: Migration periods used for *Turdus merula*.

https://doi.org/10.21436/inbor.16917180

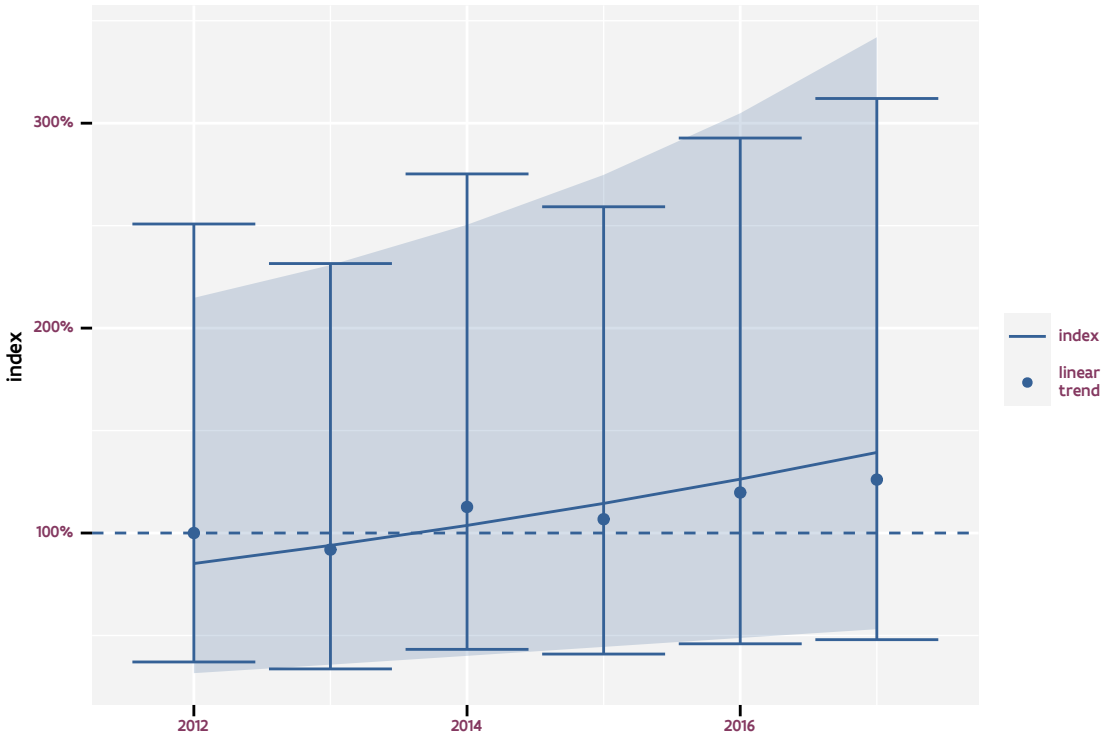

Figure 4.74: Indices and linear trend for *Turdus merula*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

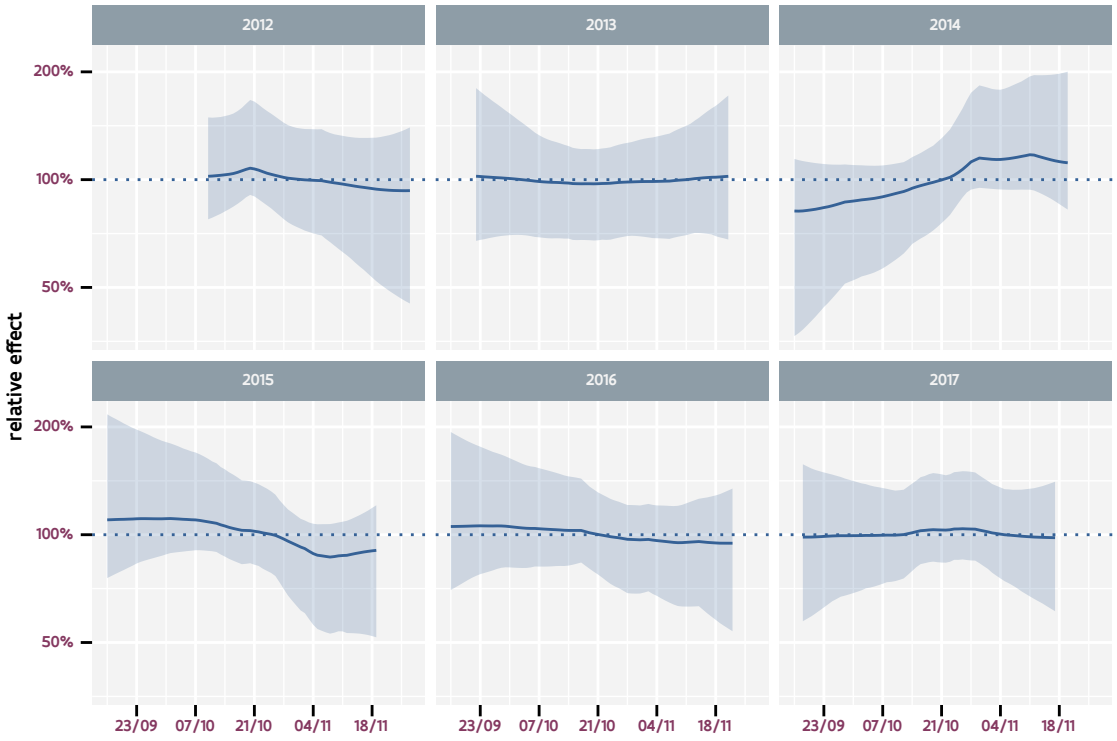

Figure 4.75: Seasonal pattern for *Turdus merula*.

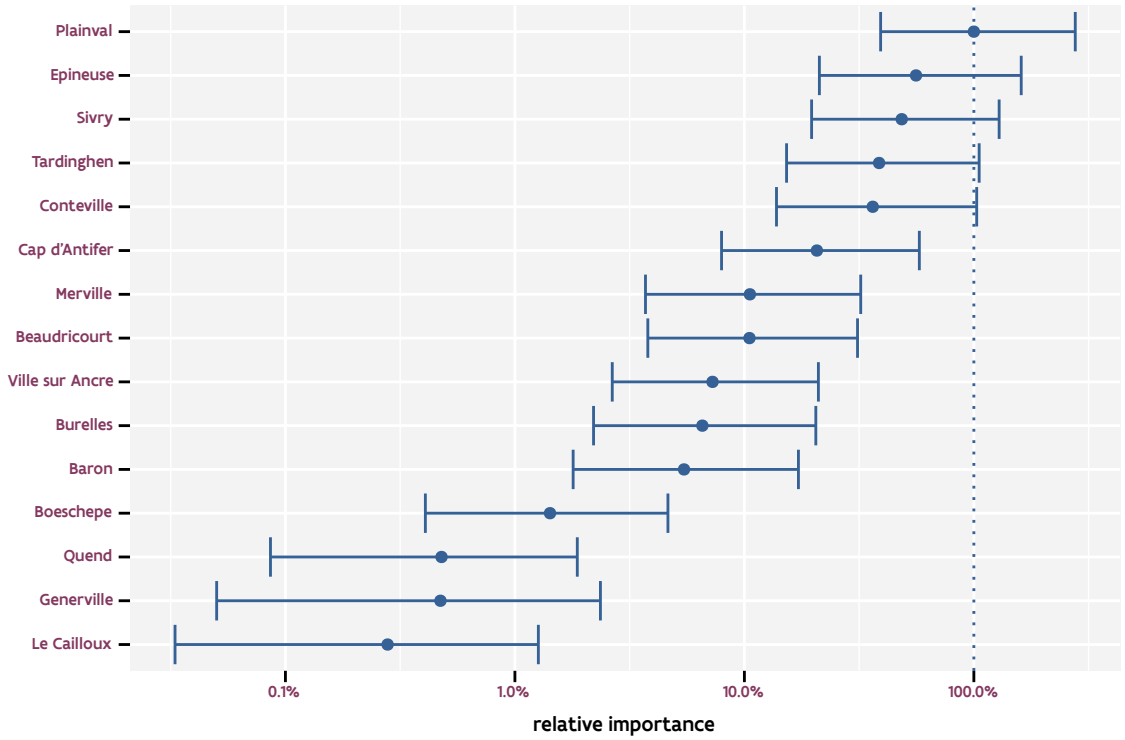

Figure 4.76: Relative importance per site for *Turdus merula*.

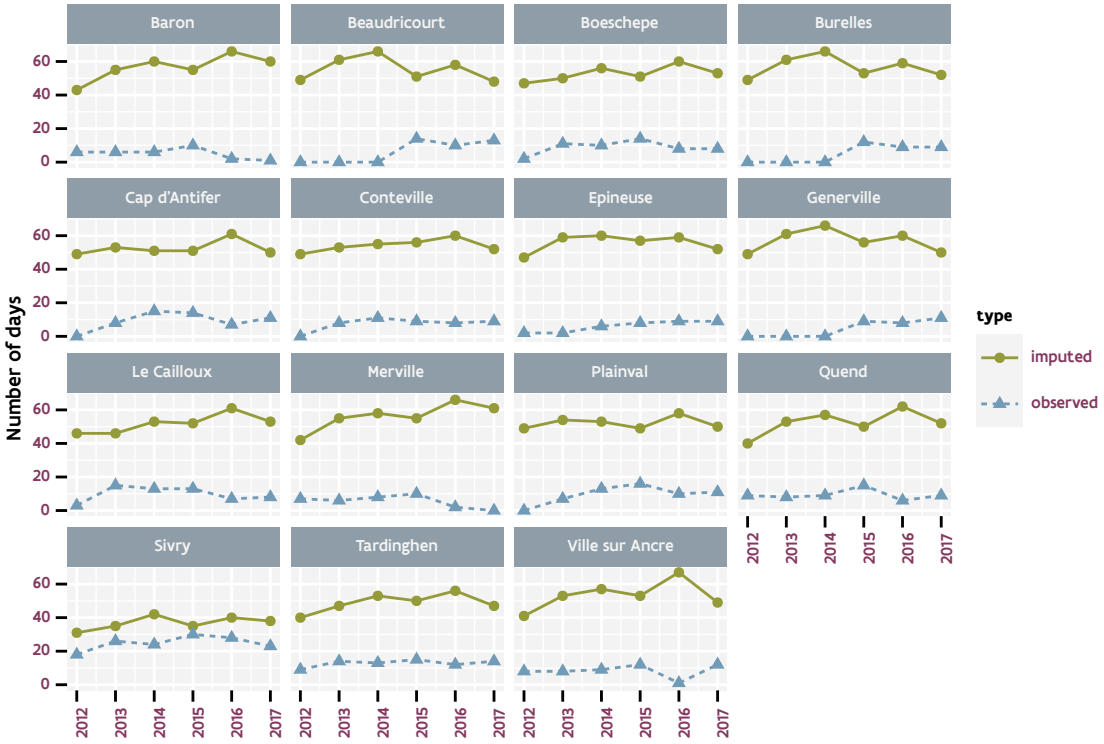

Figure 4.77: Number of days with observations per site and per year for *Turdus merula*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

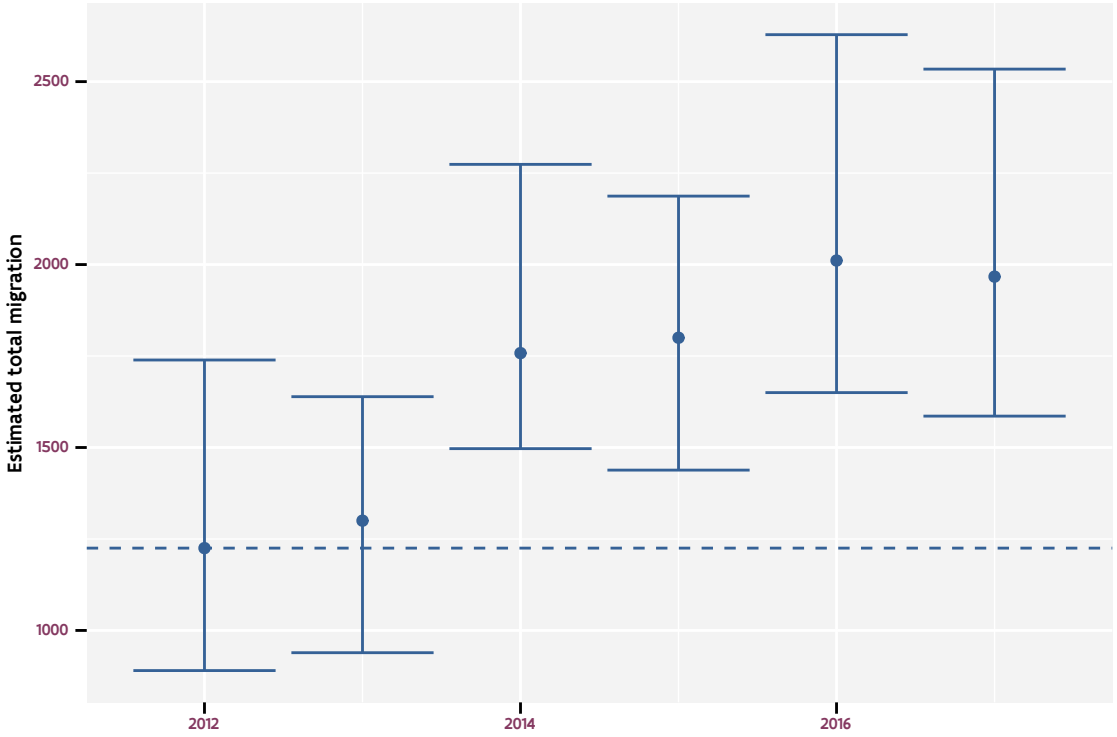

Figure 4.78: Imputed total of *Turdus merula* during the migration period.

4.14 *TURDUS PILARIS*

- English: fieldfare
- French: grive litorne
- Dutch: kramsvogel
- EURING: 11980

More information on *Turdus pilaris*: https://www.gbif.org/species/2490737

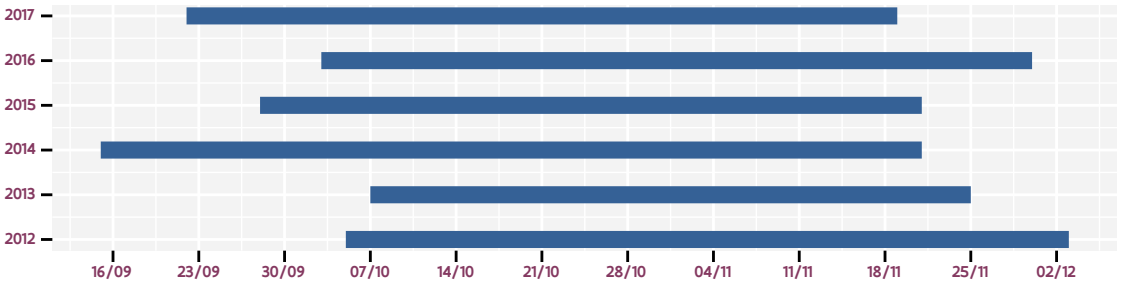

Figure 4.79: Migration periods used for *Turdus pilaris*.

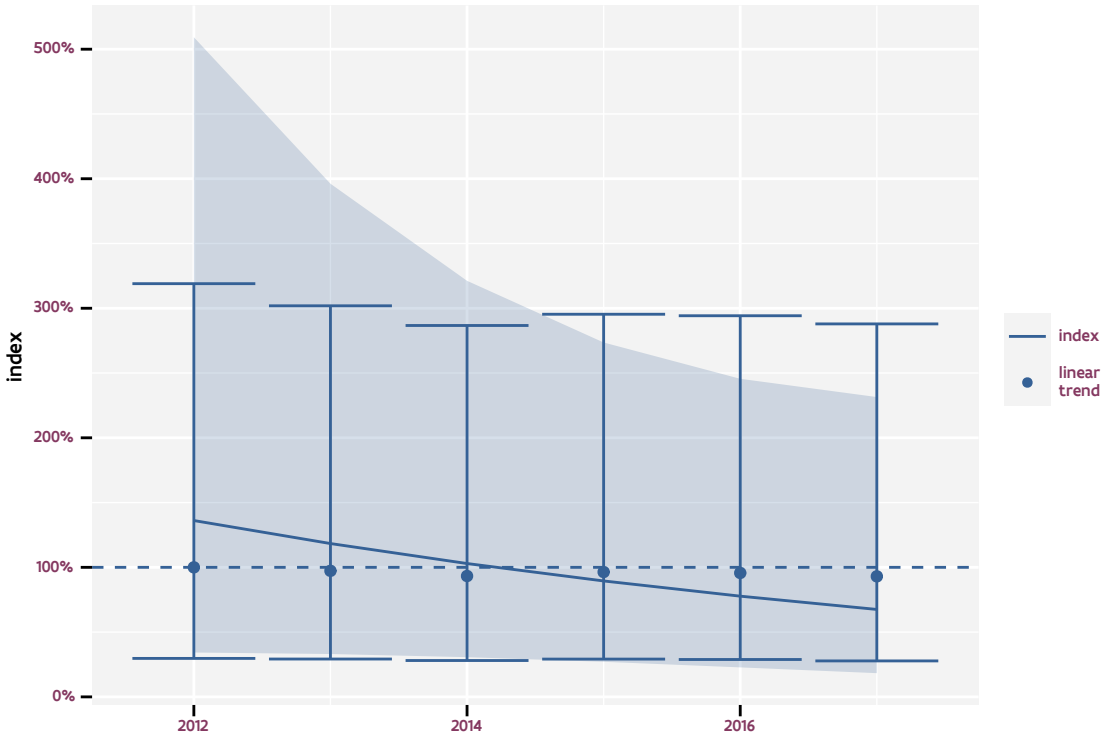

Figure 4.80: Indices and linear trend for *Turdus pilaris*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

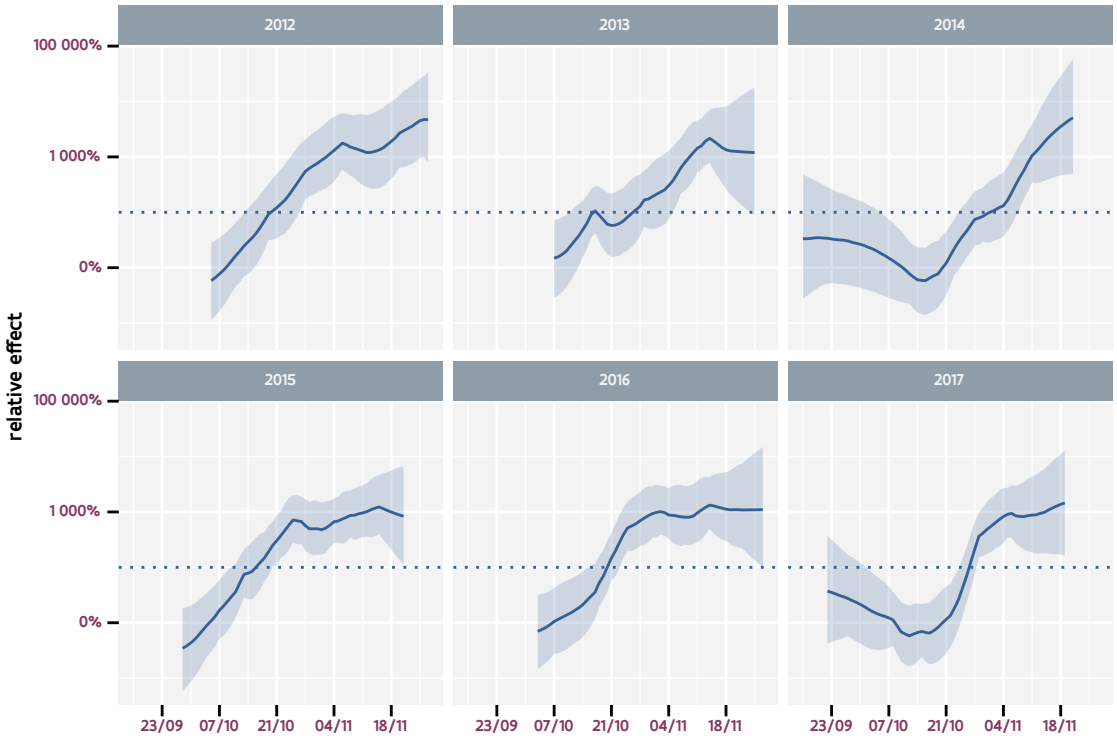

Figure 4.81: Seasonal pattern for *Turdus pilaris*.

https://doi.org/10.21436/inbor.16917180

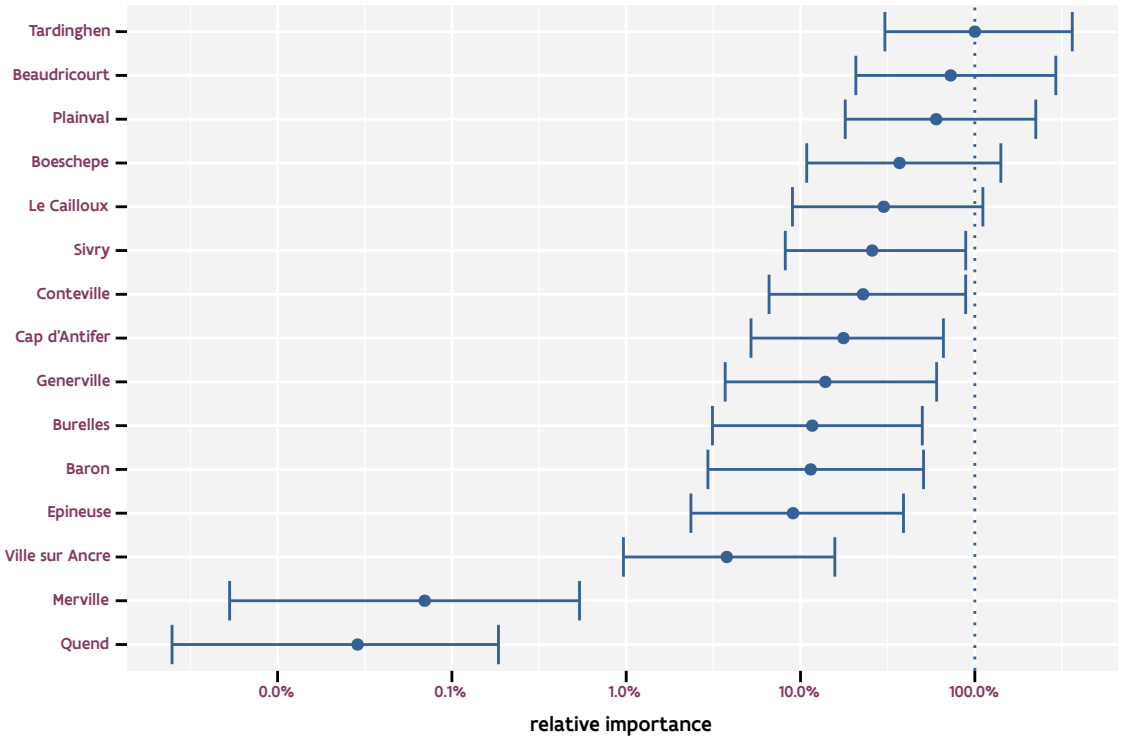

Figure 4.82: Relative importance per site for *Turdus pilaris*.

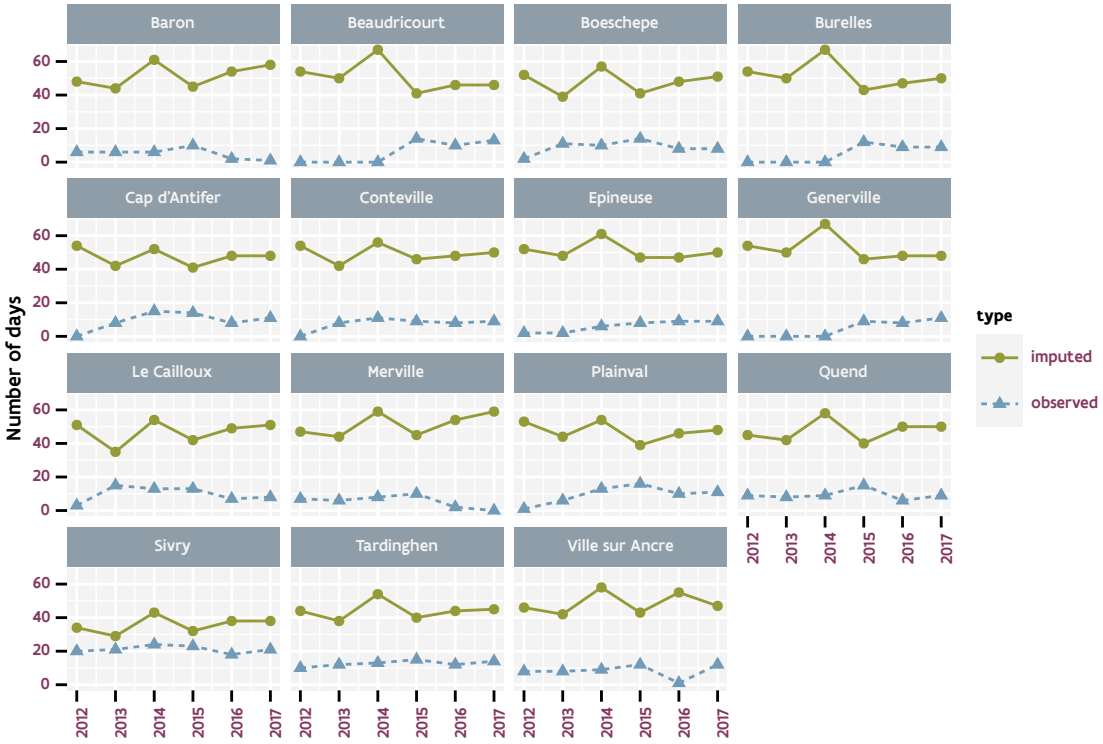

Figure 4.83: Number of days with observations per site and per year for *Turdus pilaris*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

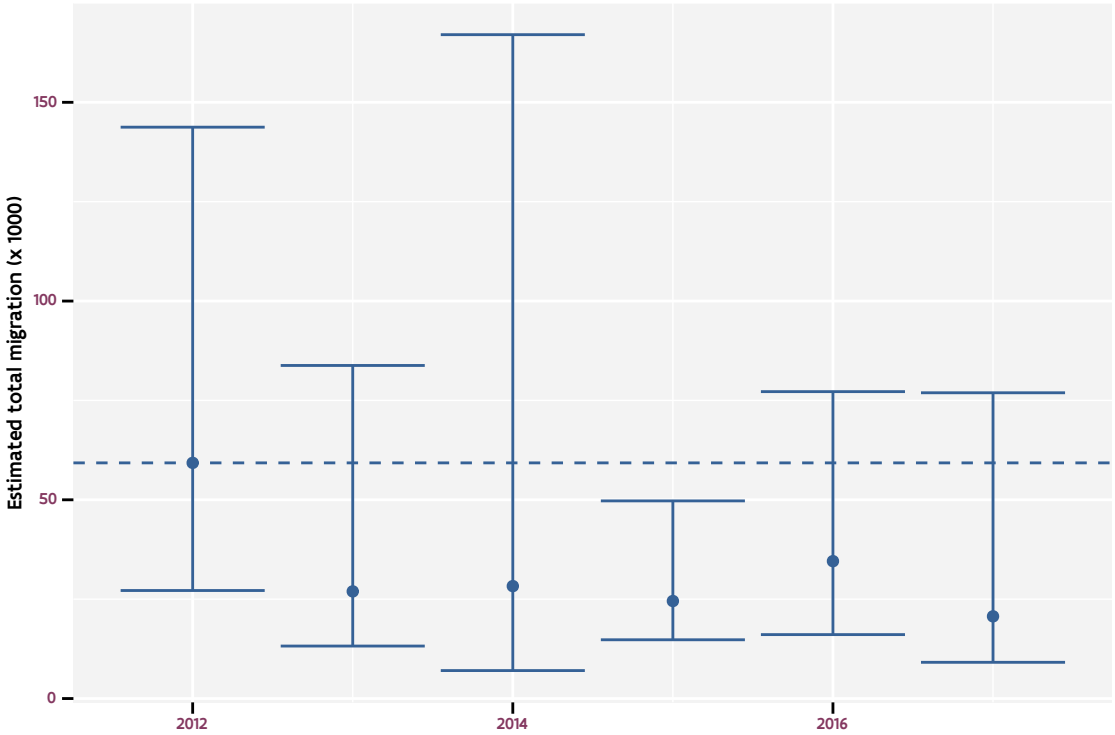

Figure 4.84: Imputed total of *Turdus pilaris* during the migration period.

4.15 *TURDUS PHILOMELOS*

- English: song thrush
- French: grive musicienne
- Dutch: zanglijster
- EURING: 12000

More information on *Turdus philomelos*: https://www.gbif.org/species/7901064

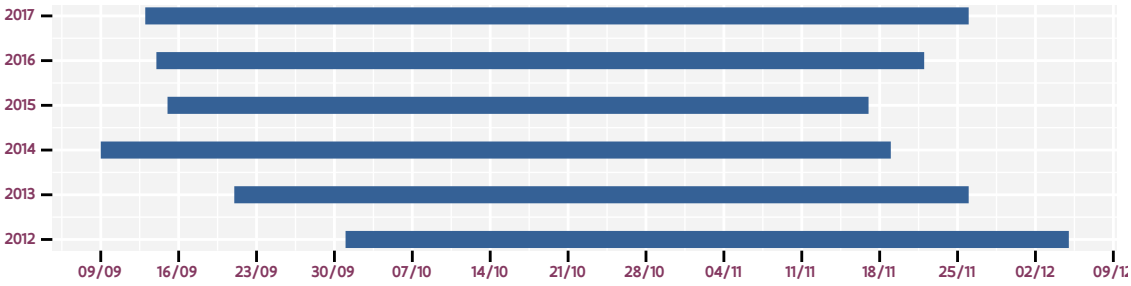

Figure 4.85: Migration periods used for *Turdus philomelos*.

https://doi.org/10.21436/inbor.16917180

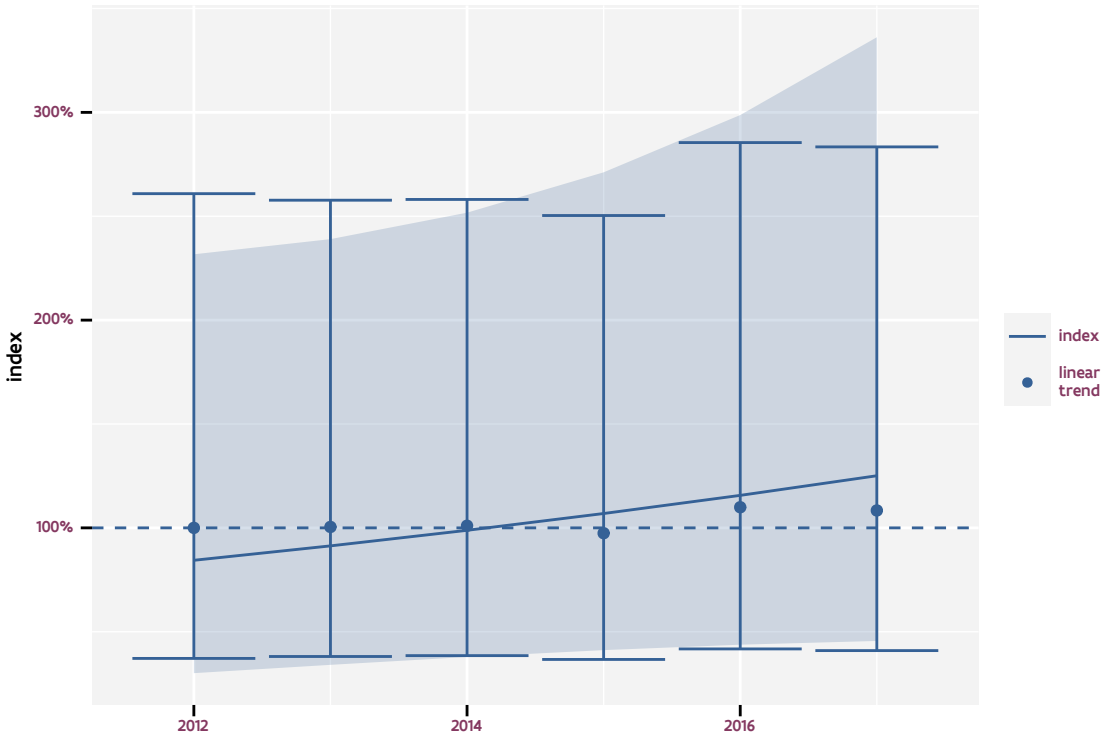

Figure 4.86: Indices and linear trend for *Turdus philomelos*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

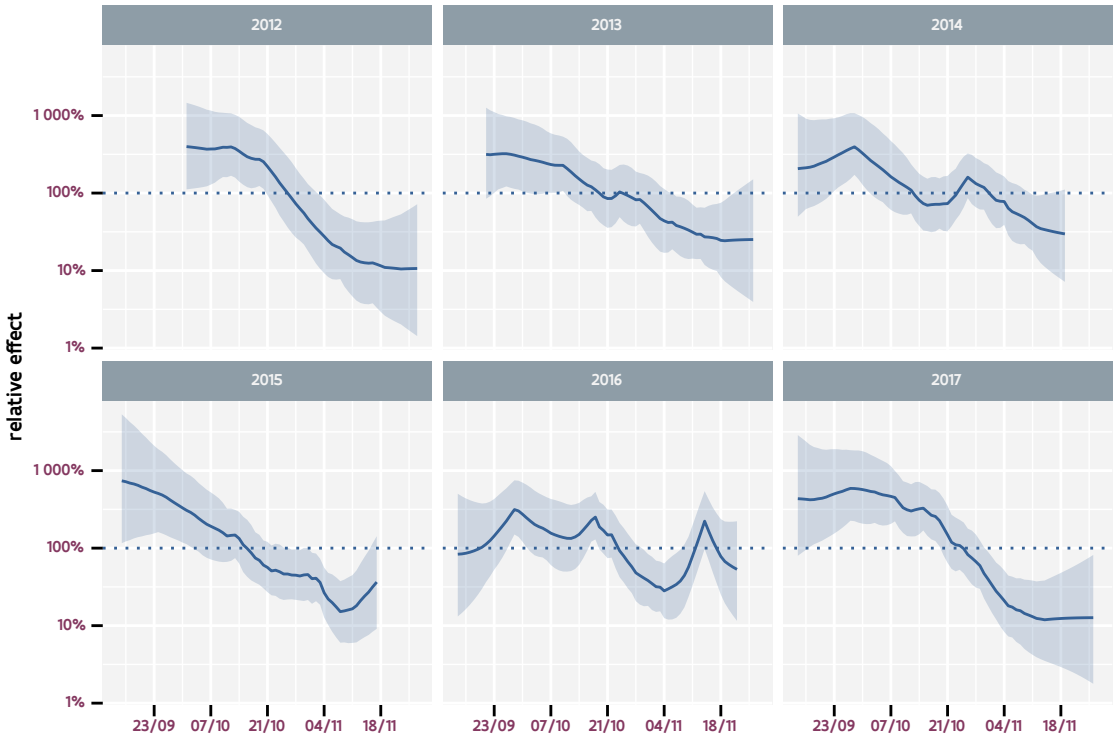

Figure 4.87: Seasonal pattern for *Turdus philomelos*.

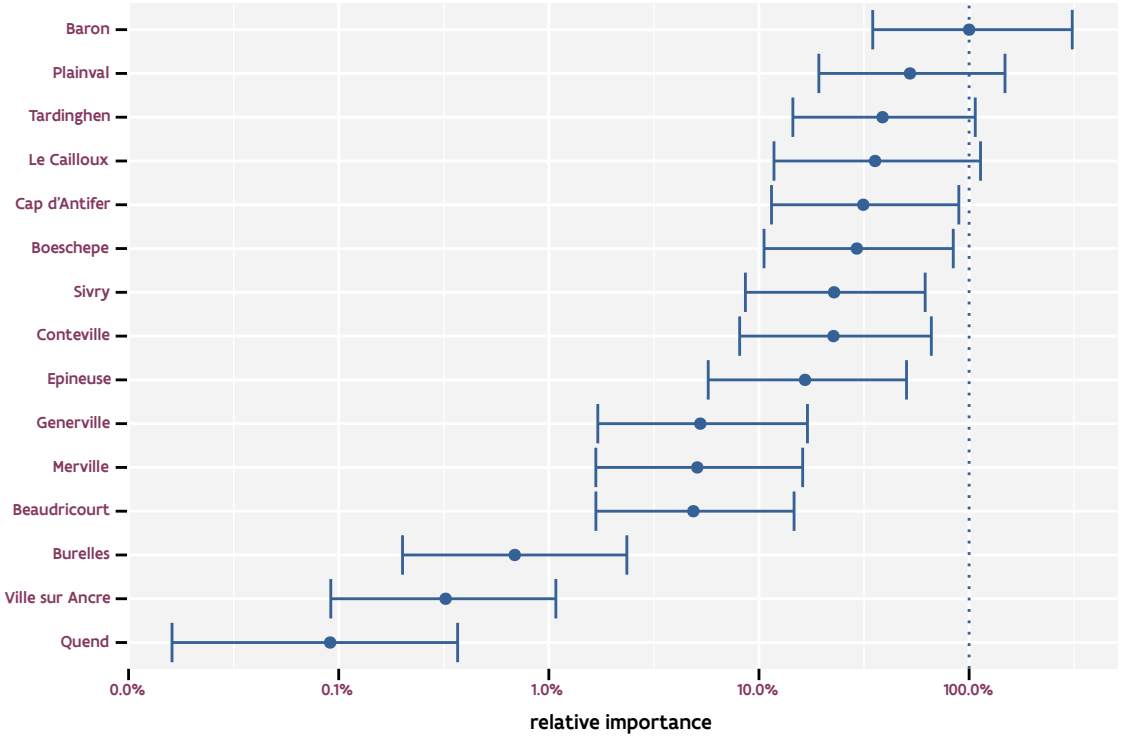

Figure 4.88: Relative importance per site for *Turdus philomelos*.

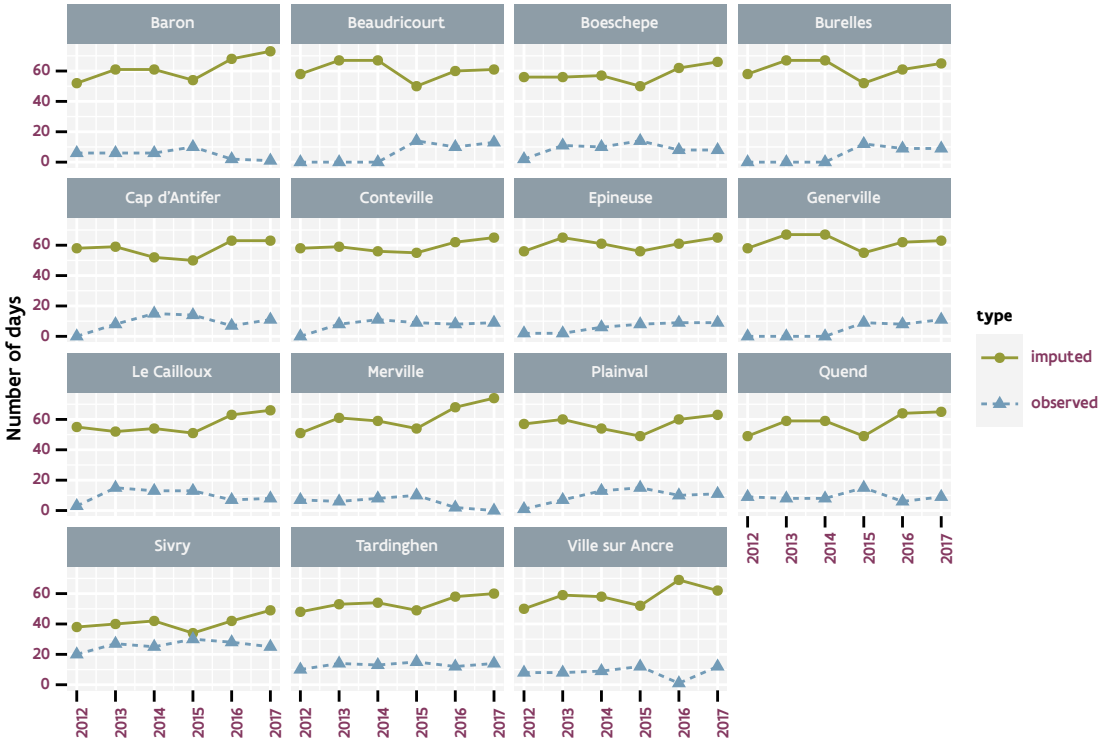

Figure 4.89: Number of days with observations per site and per year for *Turdus philomelos*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

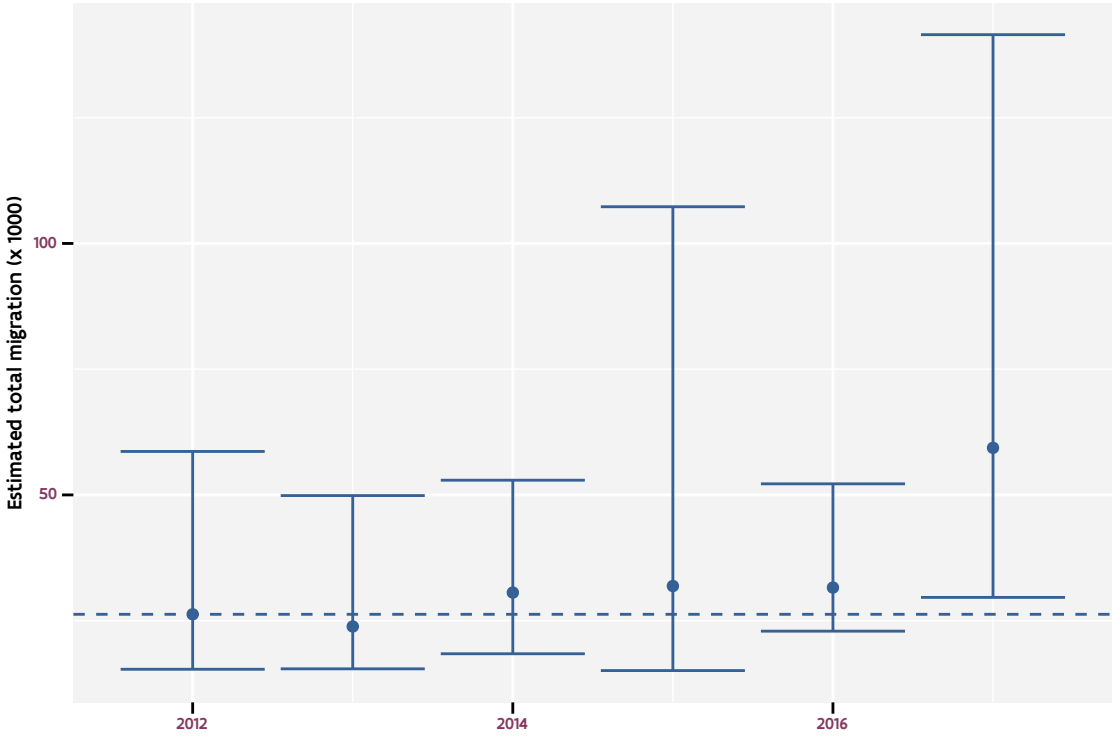

Figure 4.90: Imputed total of *Turdus philomelos* during the migration period.

4.16 *TURDUS ILIACUS*

- English: redwing
- French: grive mauvis
- Dutch: koperwiek
- EURING: 12010

More information on *Turdus iliacus*: https://www.gbif.org/species/2490781

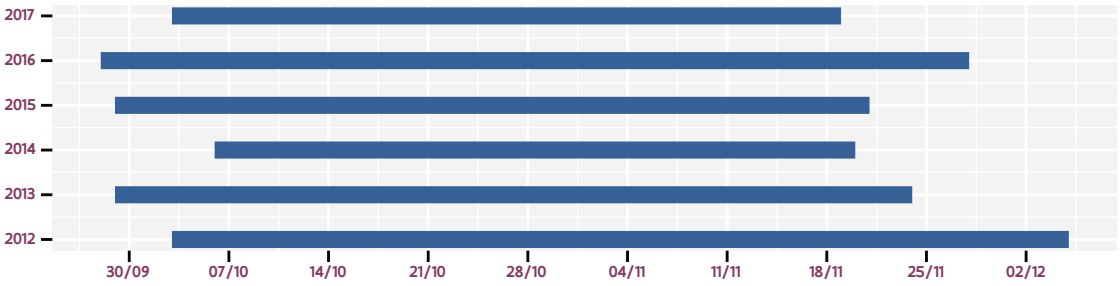

Figure 4.91: Migration periods used for *Turdus iliacus*.

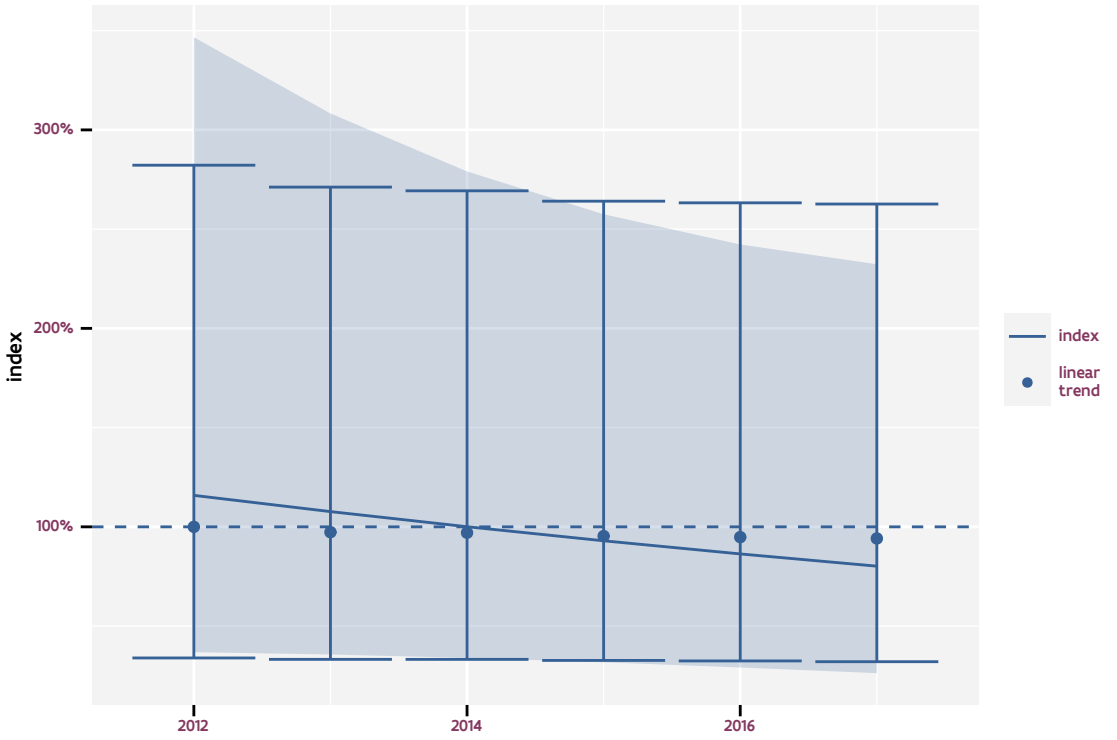

Figure 4.92: Indices and linear trend for *Turdus iliacus*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

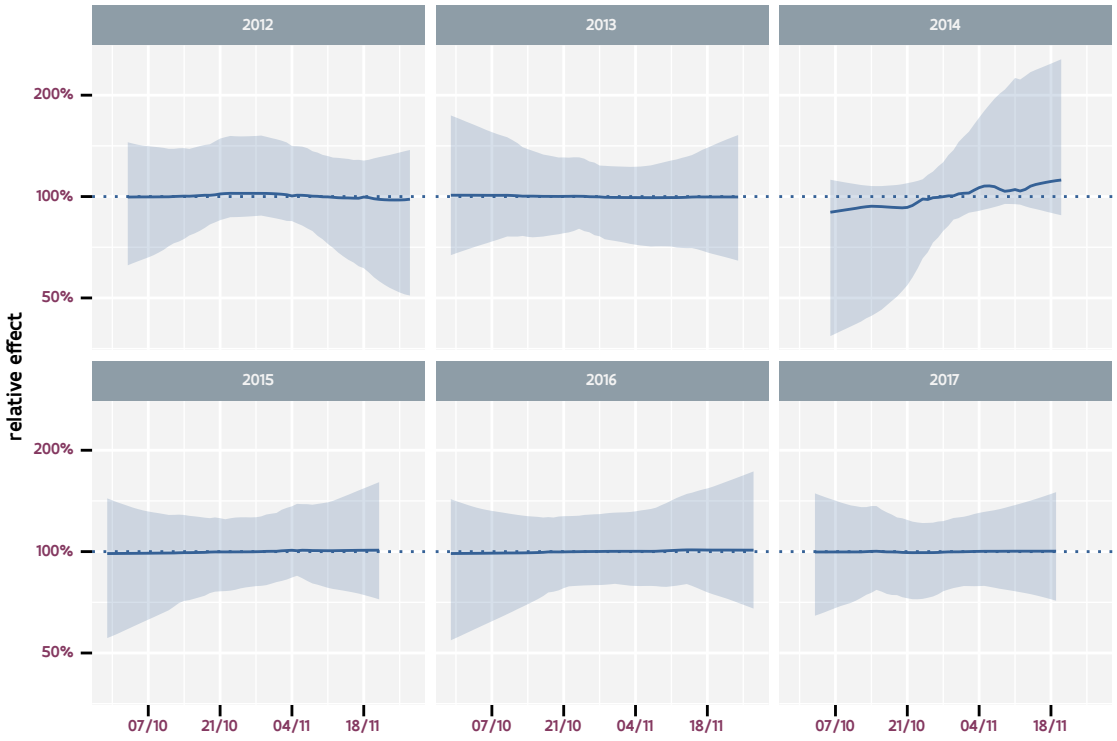

Figure 4.93: Seasonal pattern for *Turdus iliacus*.

https://doi.org/10.21436/inbor.16917180

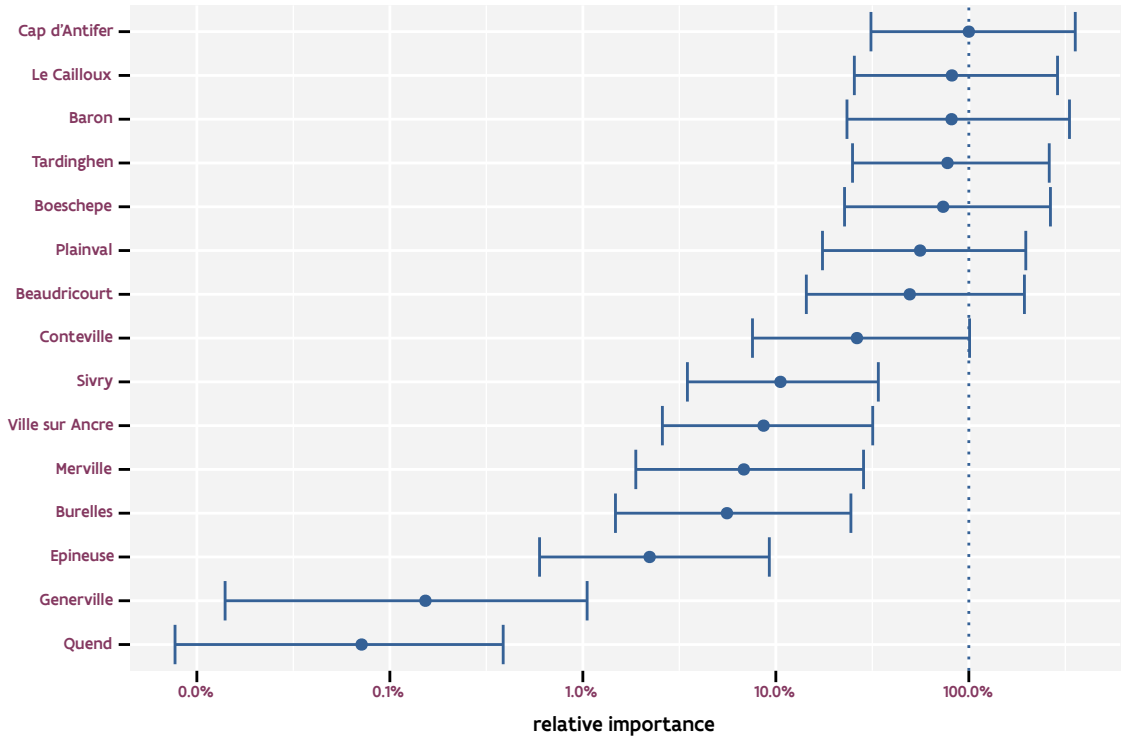

Figure 4.94: Relative importance per site for *Turdus iliacus*.

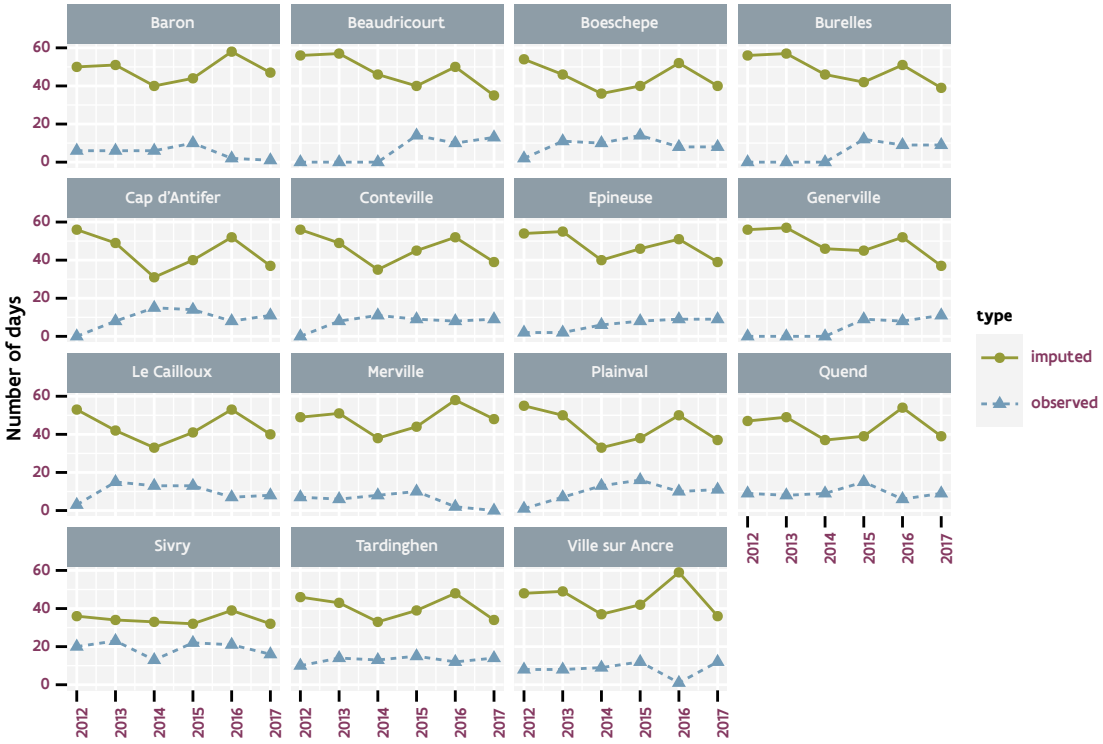

Figure 4.95: Number of days with observations per site and per year for *Turdus iliacus*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

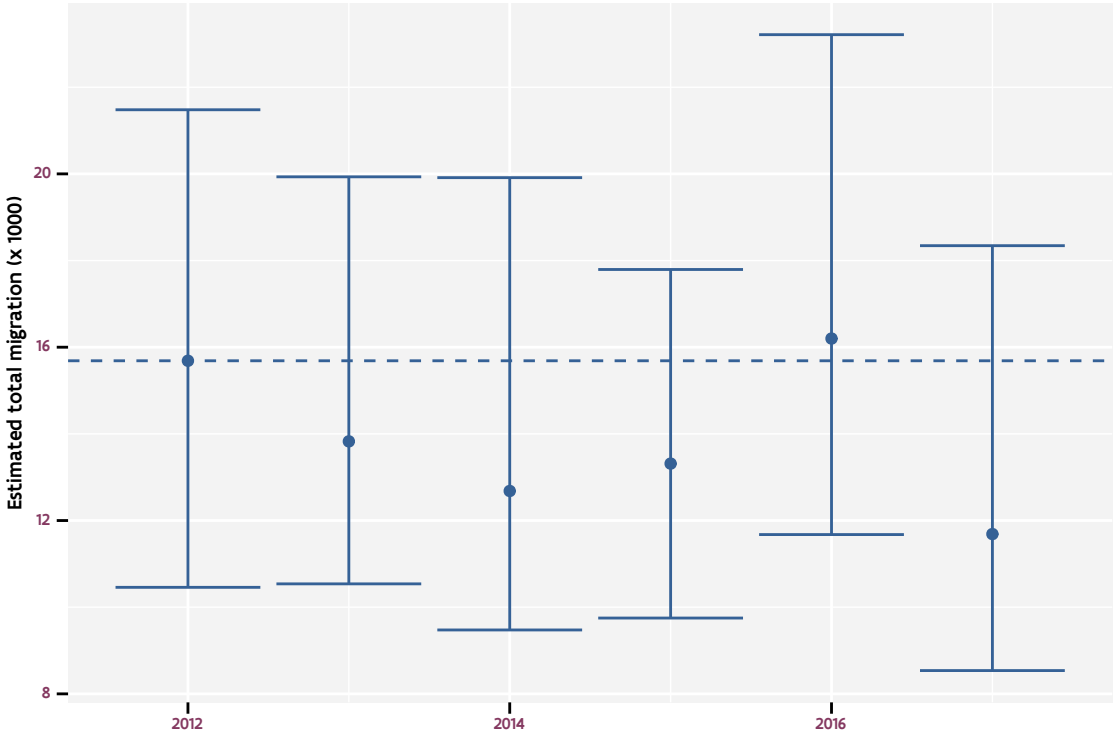

Figure 4.96: Imputed total of *Turdus iliacus* during the migration period.

4.17 *TURDUS VISCIVORUS*

- English: mistle thrush
- French: grive draine
- Dutch: grote lijster
- EURING: 12020

More information on *Turdus viscivorus*: https://www.gbif.org/species/2490774

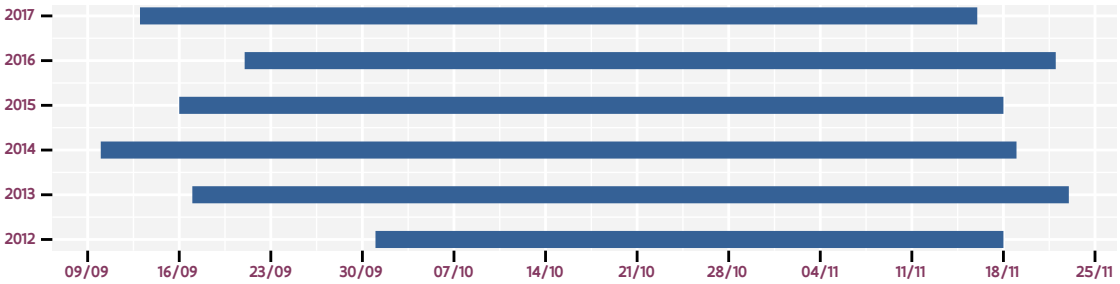

Figure 4.97: Migration periods used for *Turdus viscivorus*.

https://doi.org/10.21436/inbor.16917180

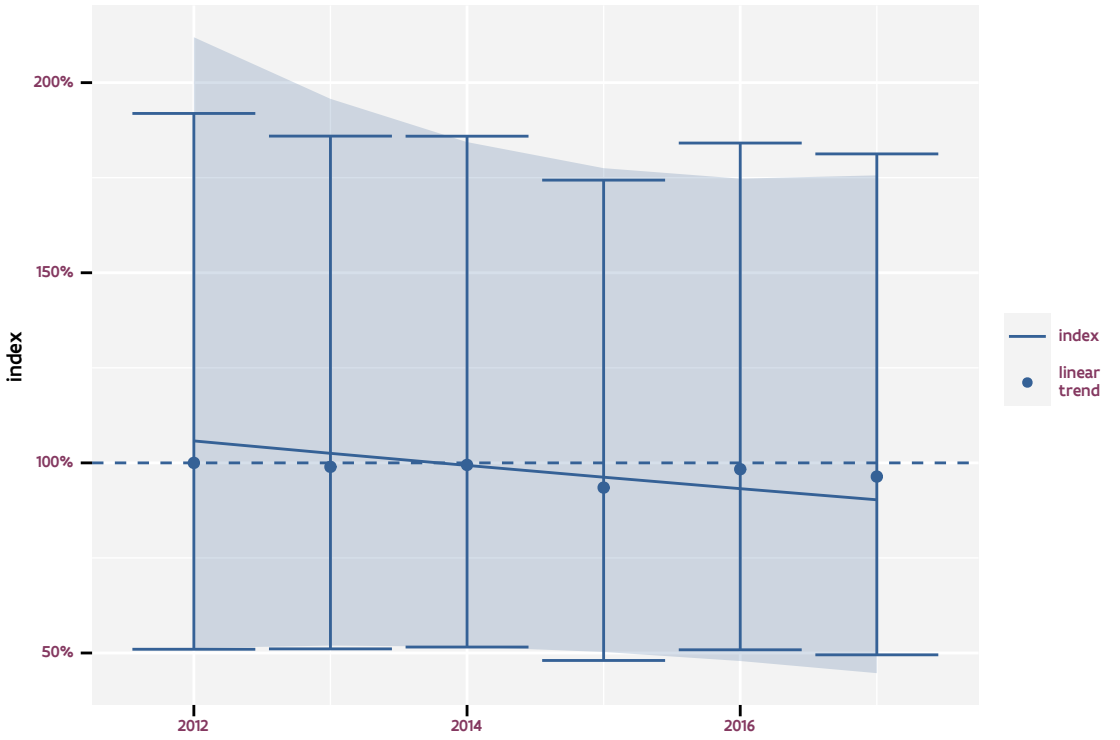

Figure 4.98: Indices and linear trend for *Turdus viscivorus*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

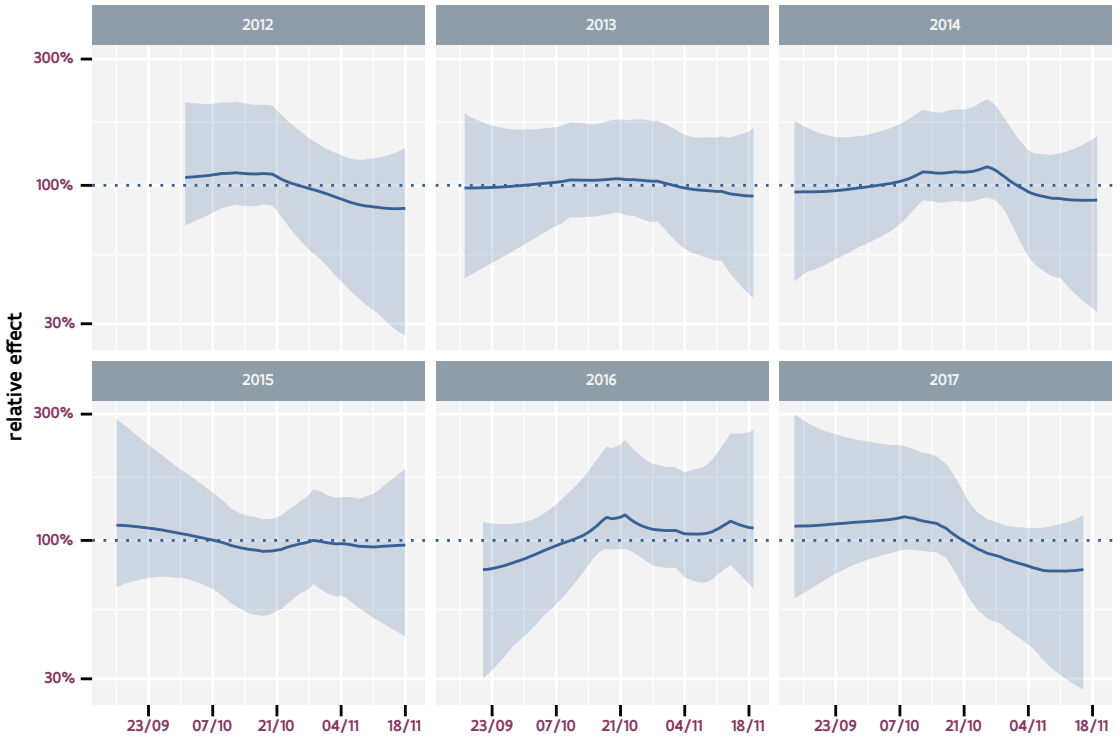

Figure 4.99: Seasonal pattern for *Turdus viscivorus*.

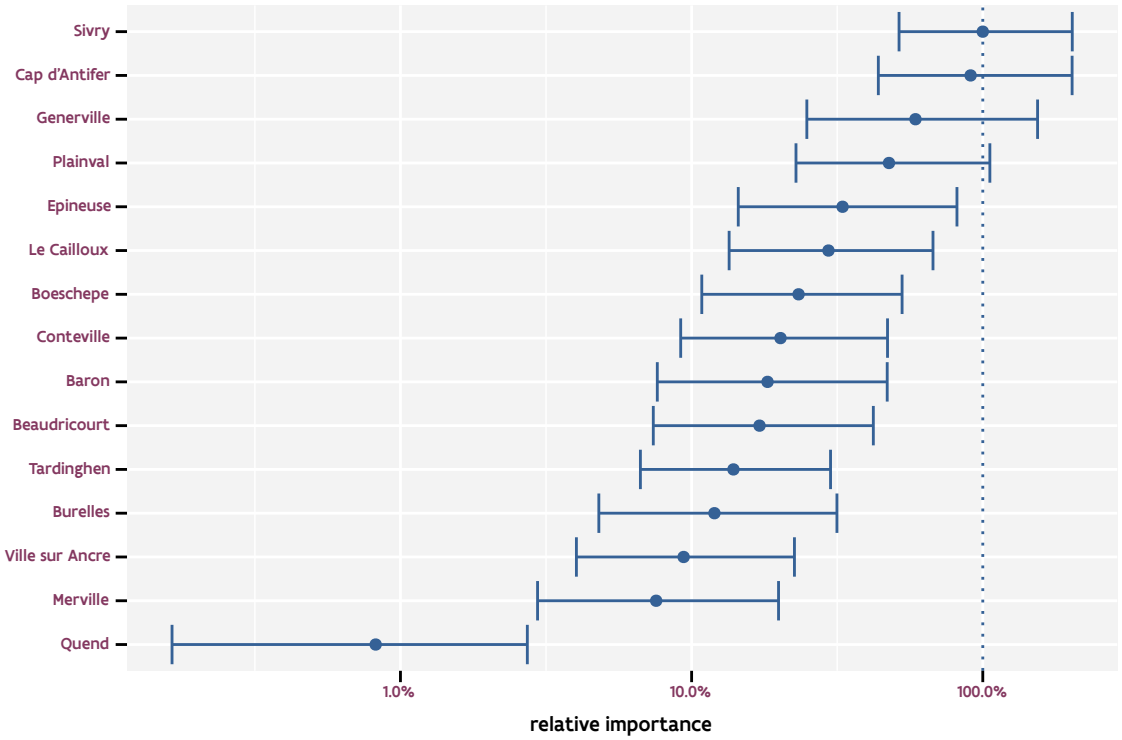

Figure 4.100: Relative importance per site for *Turdus viscivorus*.

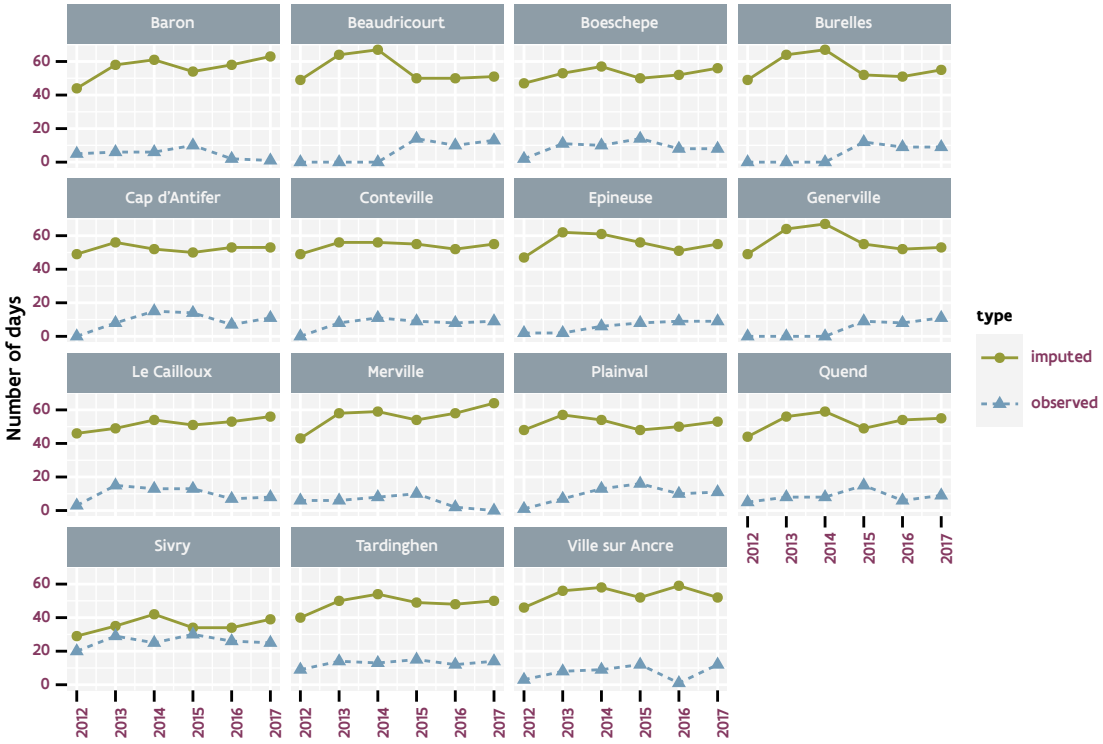

Figure 4.101: Number of days with observations per site and per year for *Turdus viscivorus*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

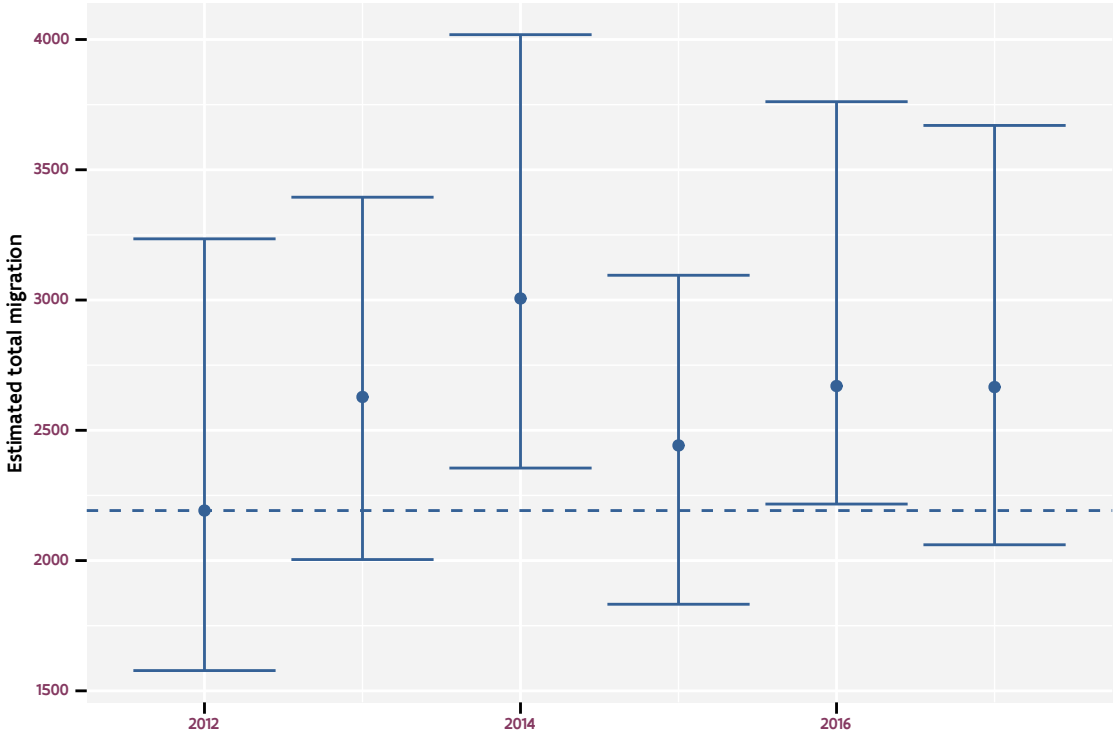

Figure 4.102: Imputed total of *Turdus viscivorus* during the migration period.

4.18 *CYANISTES CAERULEUS*

- English: Eurasian blue tit
- French: mésange bleue
- Dutch: Pimpelmees
- EURING: 14620

More information on *Cyanistes caeruleus*: https://www.gbif.org/species/2487879

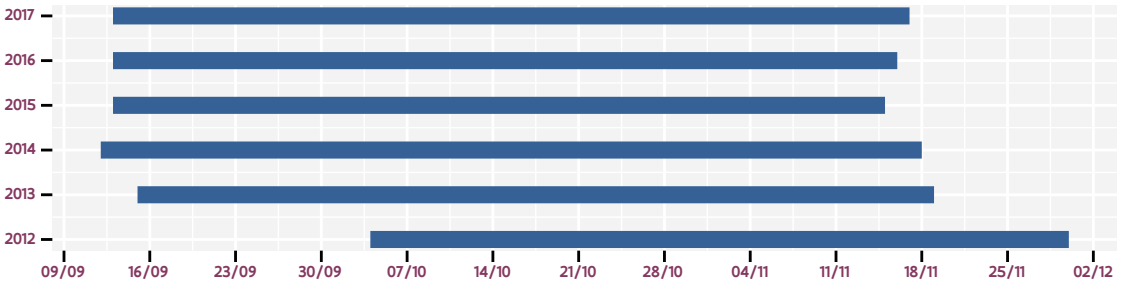

Figure 4.103: Migration periods used for *Cyanistes caeruleus*.

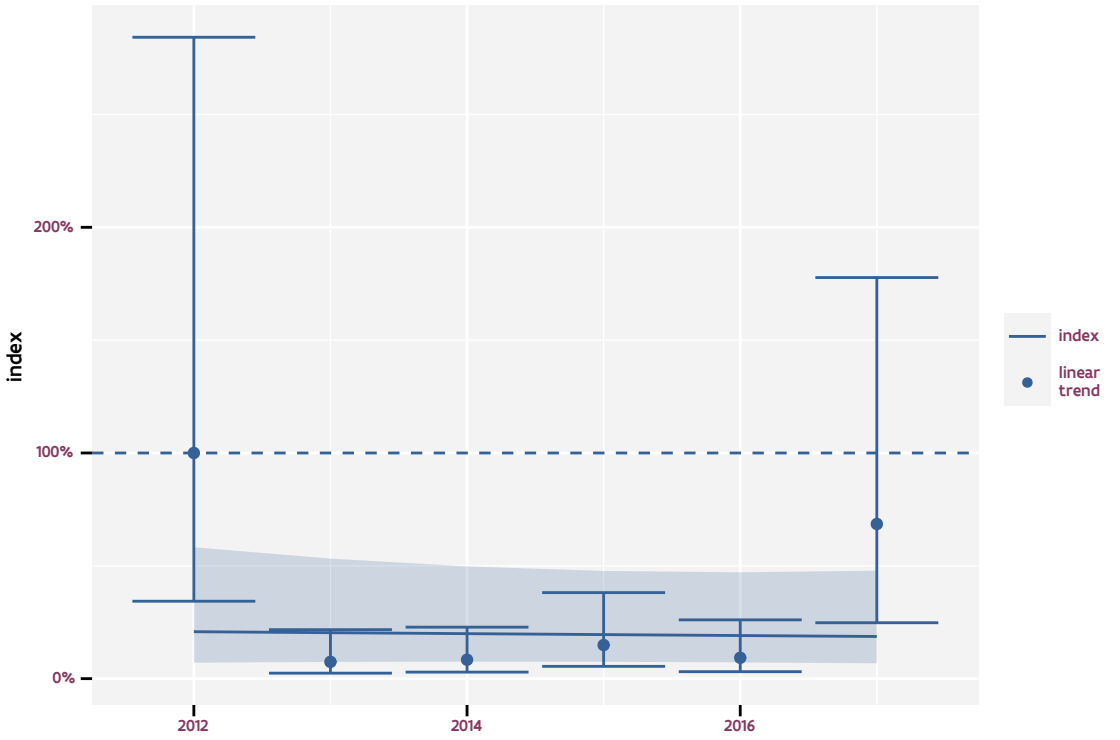

Figure 4.104: Indices and linear trend for *Cyanistes caeruleus*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

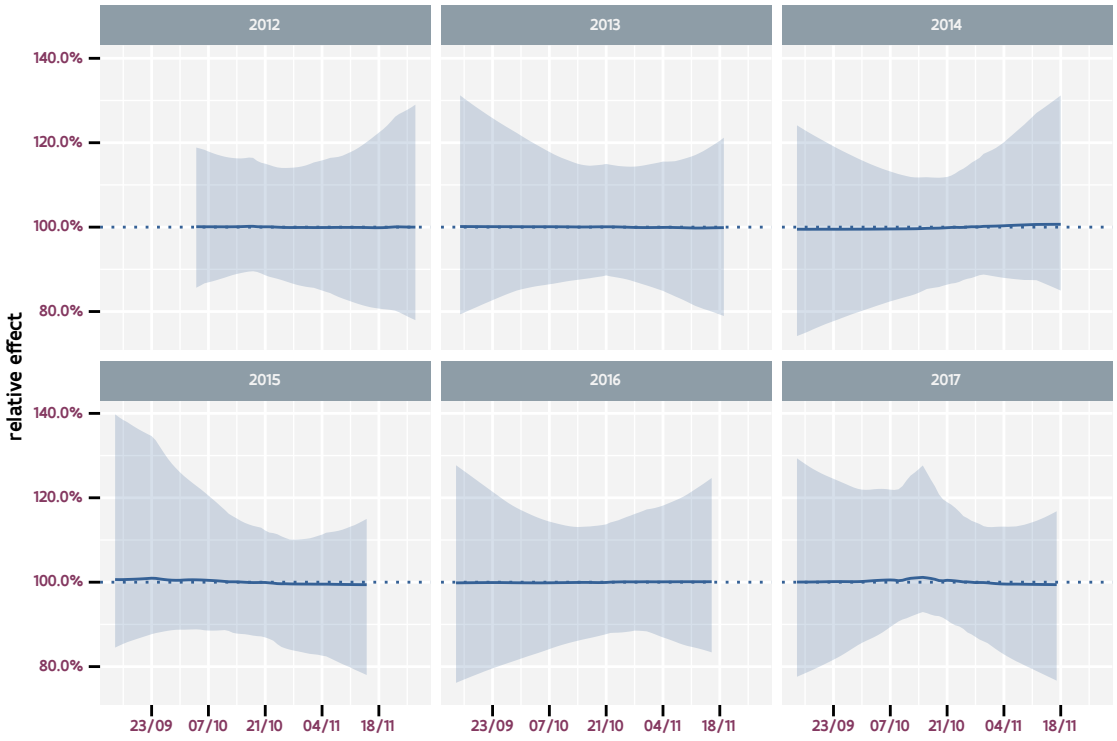

Figure 4.105: Seasonal pattern for *Cyanistes caeruleus*.

https://doi.org/10.21436/inbor.16917180

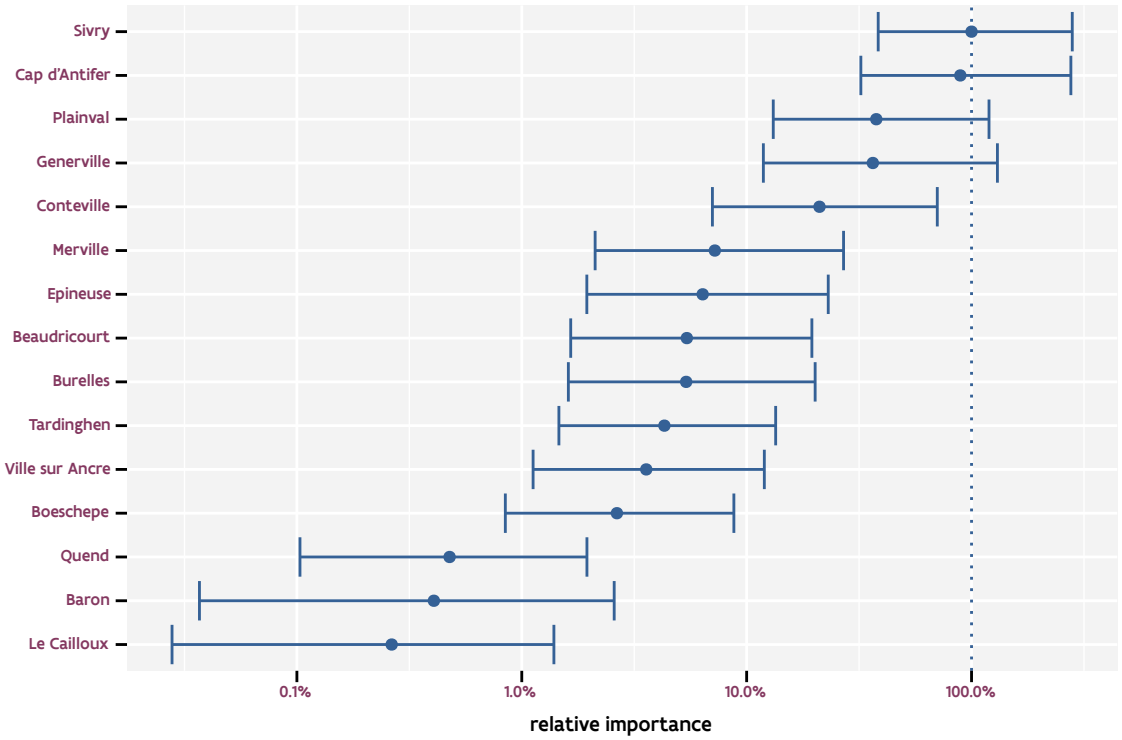

Figure 4.106: Relative importance per site for *Cyanistes caeruleus*.

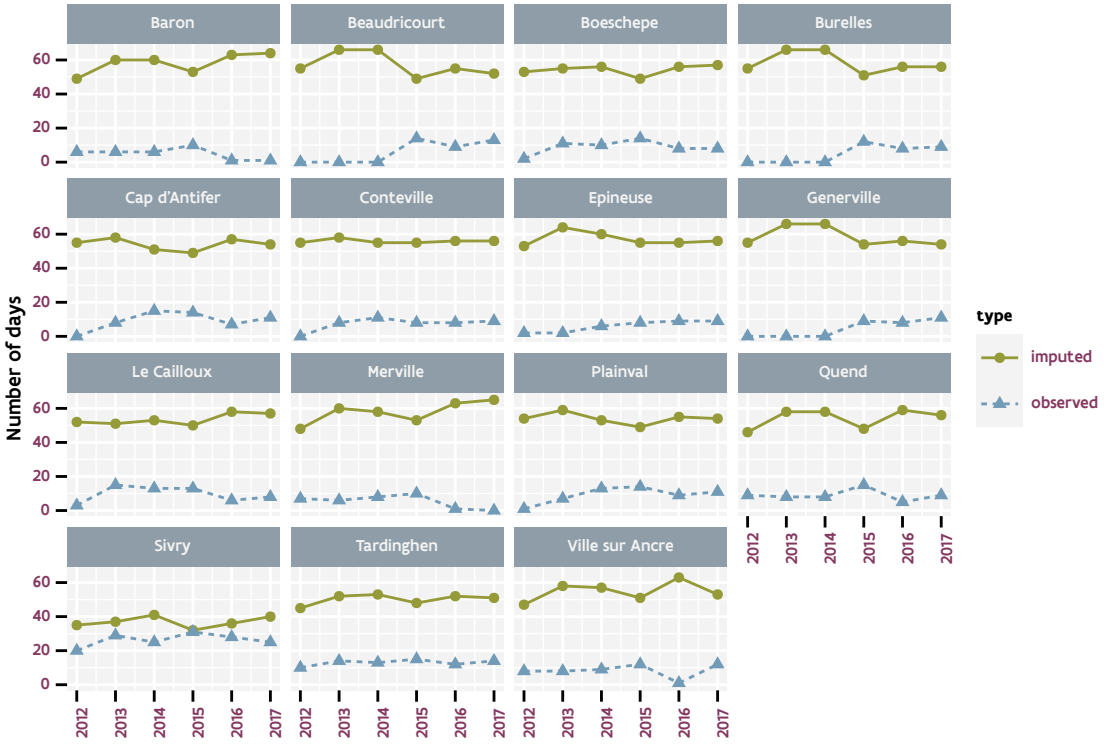

Figure 4.107: Number of days with observations per site and per year for *Cyanistes caeruleus*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

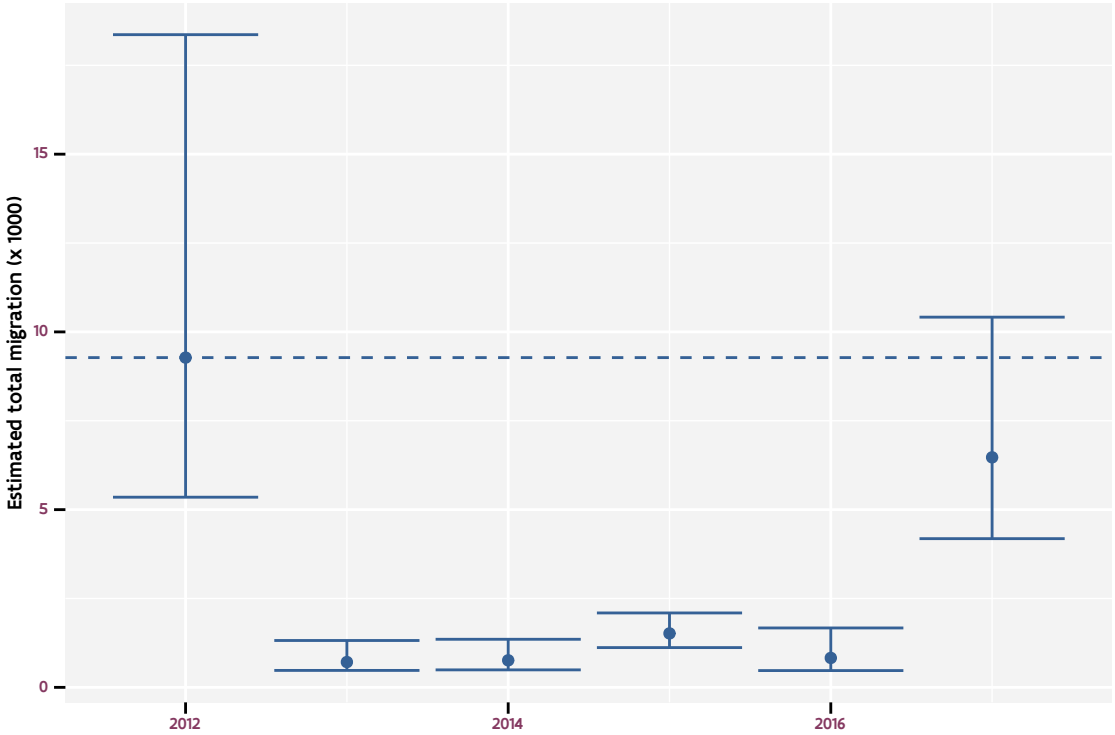

Figure 4.108: Imputed total of *Cyanistes caeruleus* during the migration period.

4.19 *PARUS MAJOR*

- English: great tit
- French: mésange charbonnière
- Dutch: koolmees
- EURING: 14640

More information on *Parus major*: https://www.gbif.org/species/9705453

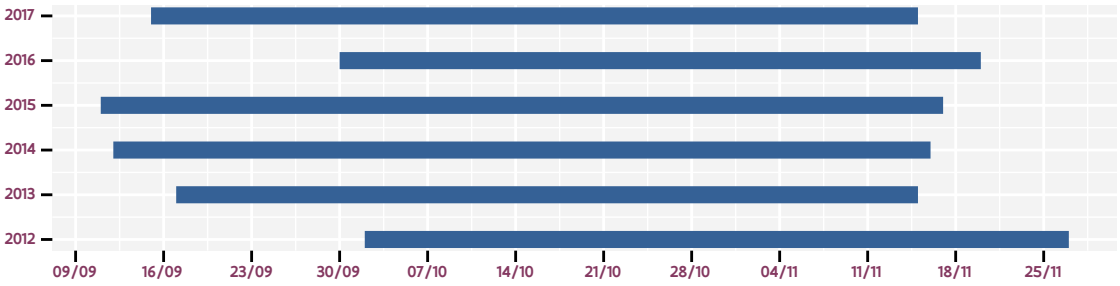

Figure 4.109: Migration periods used for *Parus major*.

https://doi.org/10.21436/inbor.16917180

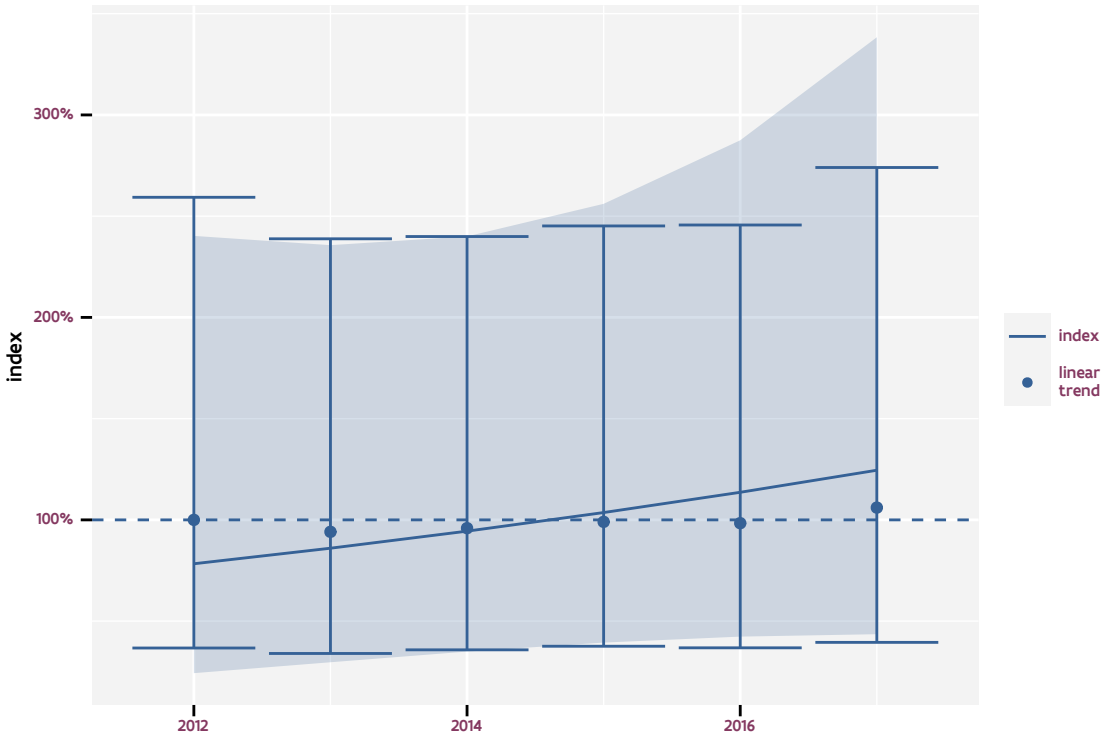

Figure 4.110: Indices and linear trend for *Parus major*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

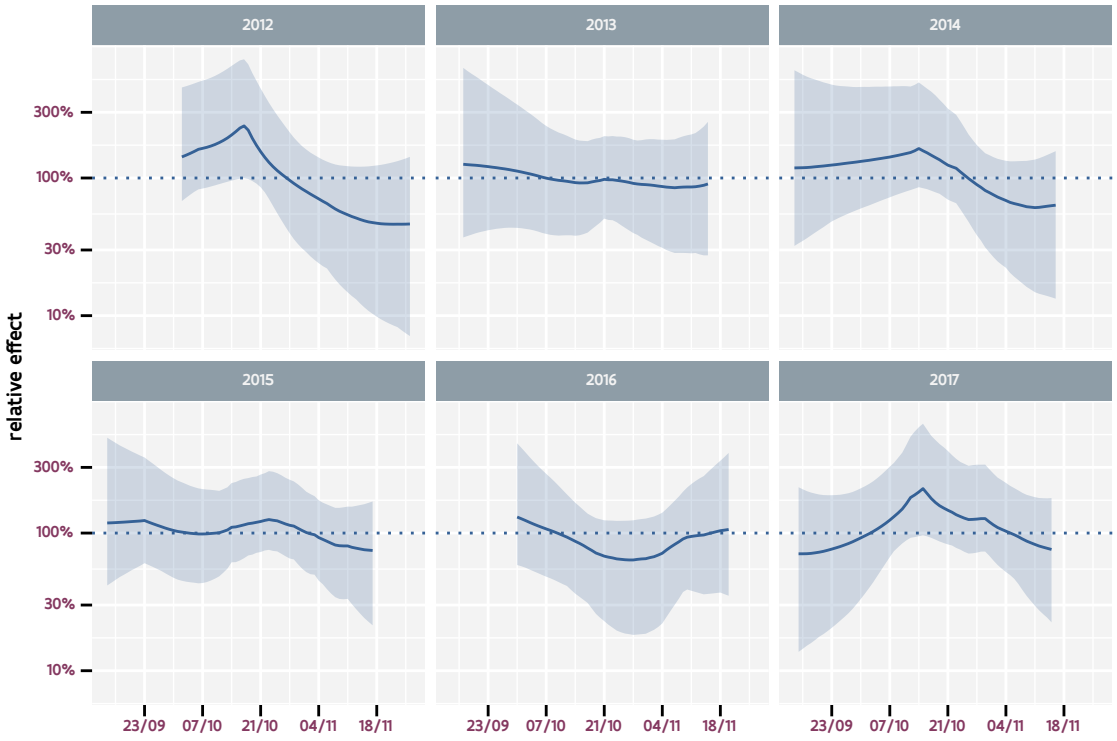

Figure 4.111: Seasonal pattern for *Parus major*.

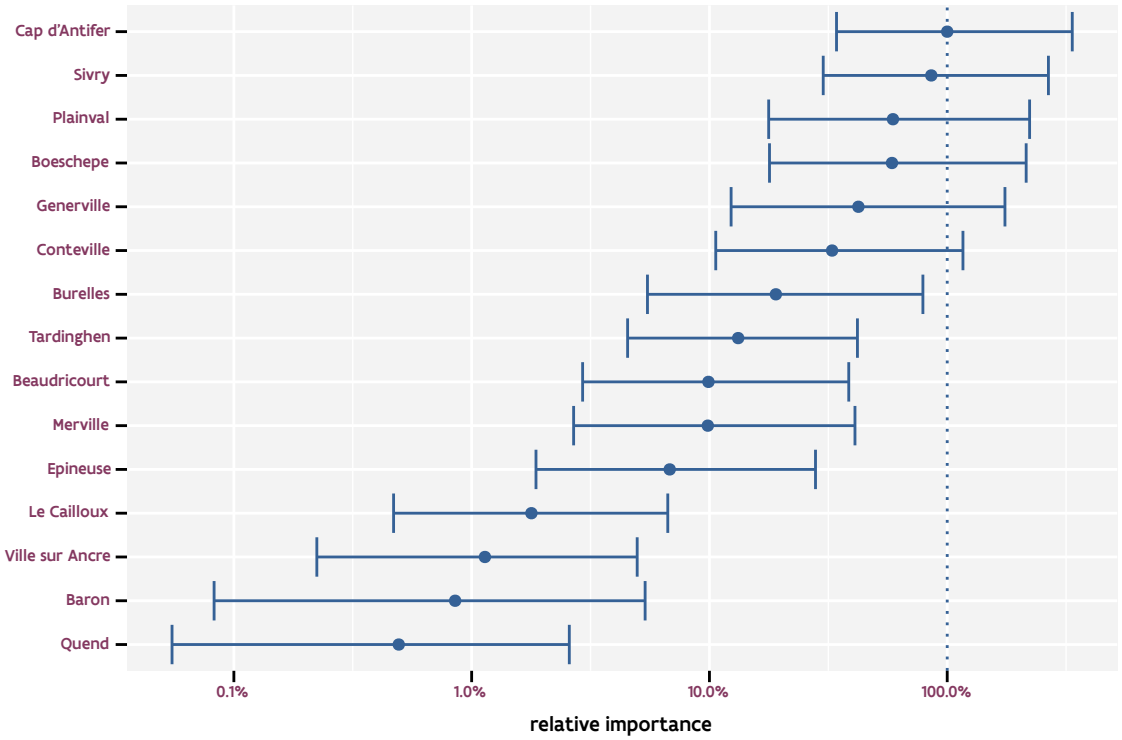

Figure 4.112: Relative importance per site for *Parus major*.

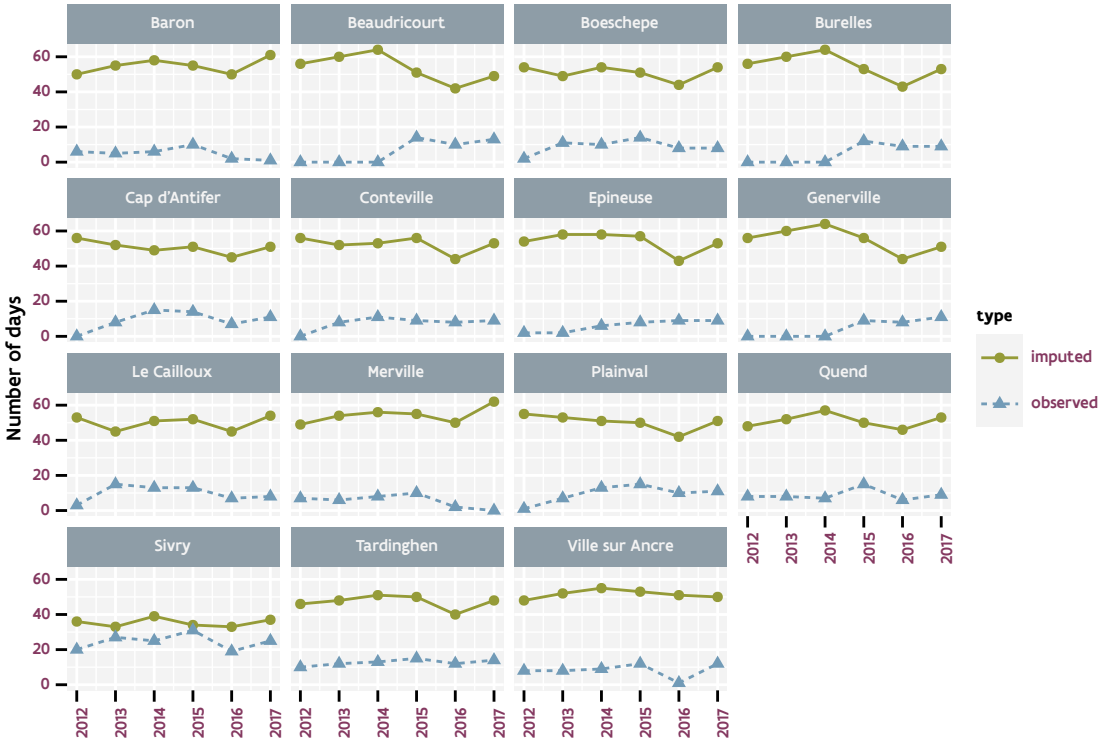

Figure 4.113: Number of days with observations per site and per year for *Parus major*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

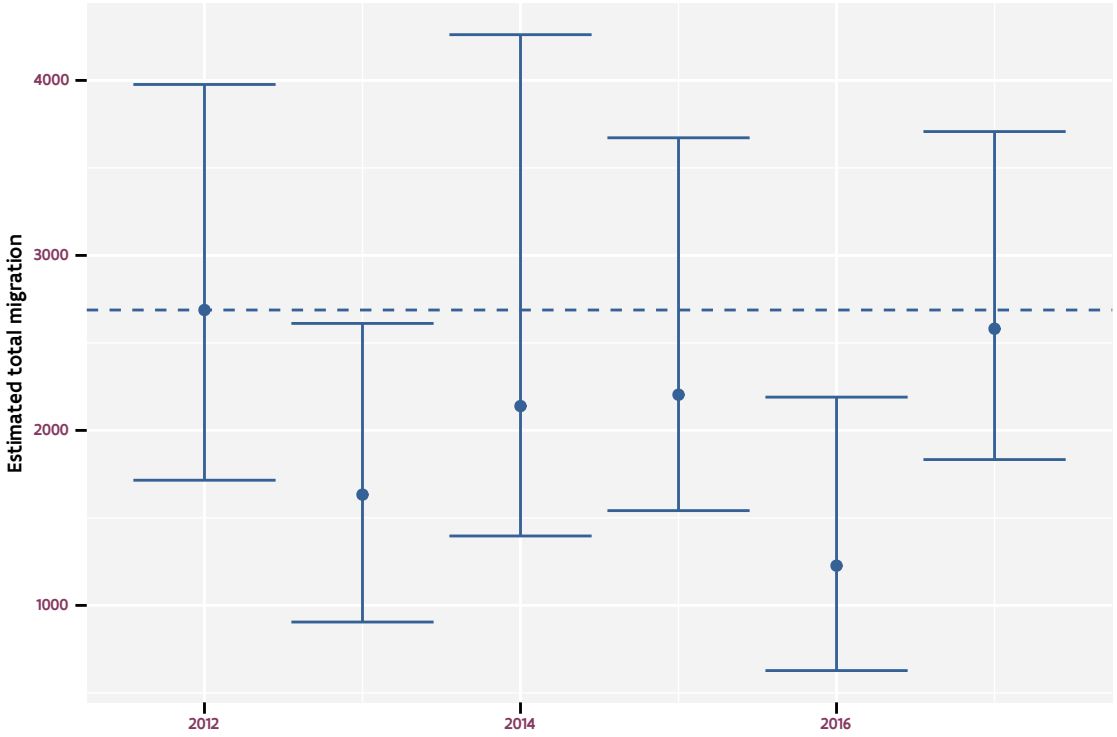

Figure 4.114: Imputed total of *Parus major* during the migration period.

4.20 *GARRULUS GLANDARIUS*

- English: jay
- French: geai des chênes
- Dutch: gaai
- EURING: 15390

More information on *Garrulus glandarius*: https://www.gbif.org/species/5229493

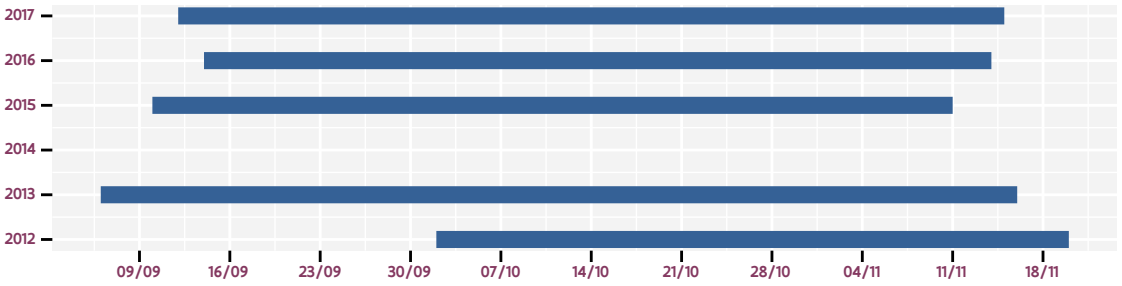

Figure 4.115: Migration periods used for *Garrulus glandarius*.

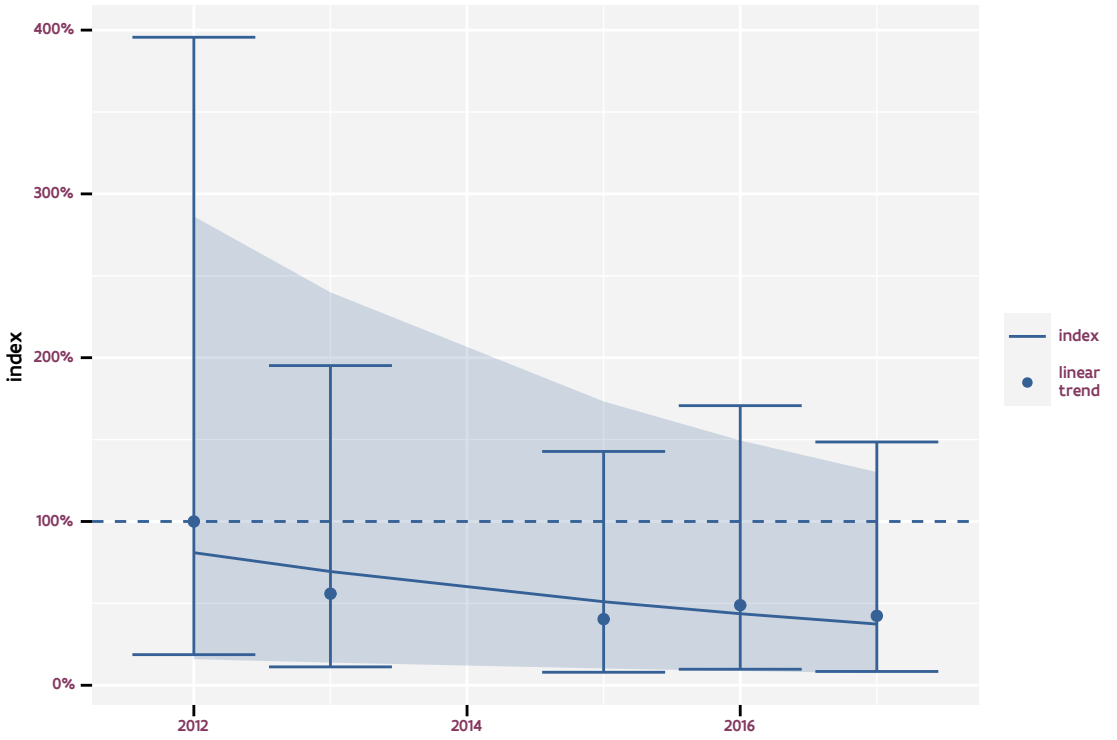

Figure 4.116: Indices and linear trend for *Garrulus glandarius*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

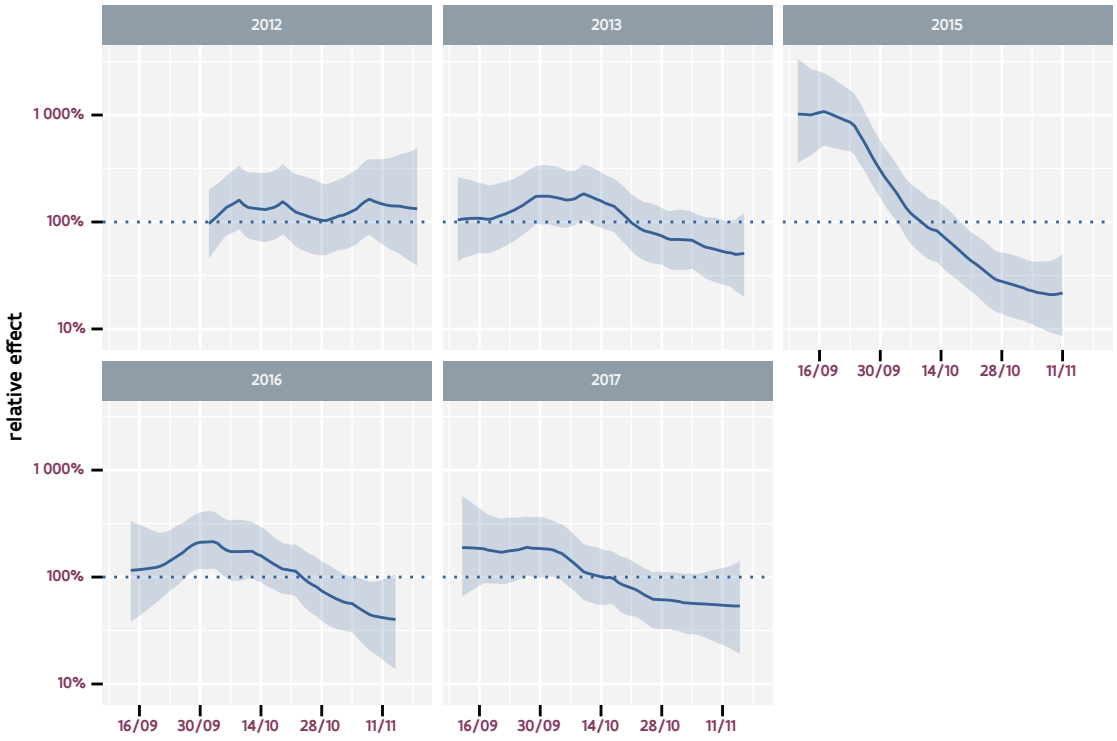

Figure 4.117: Seasonal pattern for *Garrulus glandarius*.

https://doi.org/10.21436/inbor.16917180

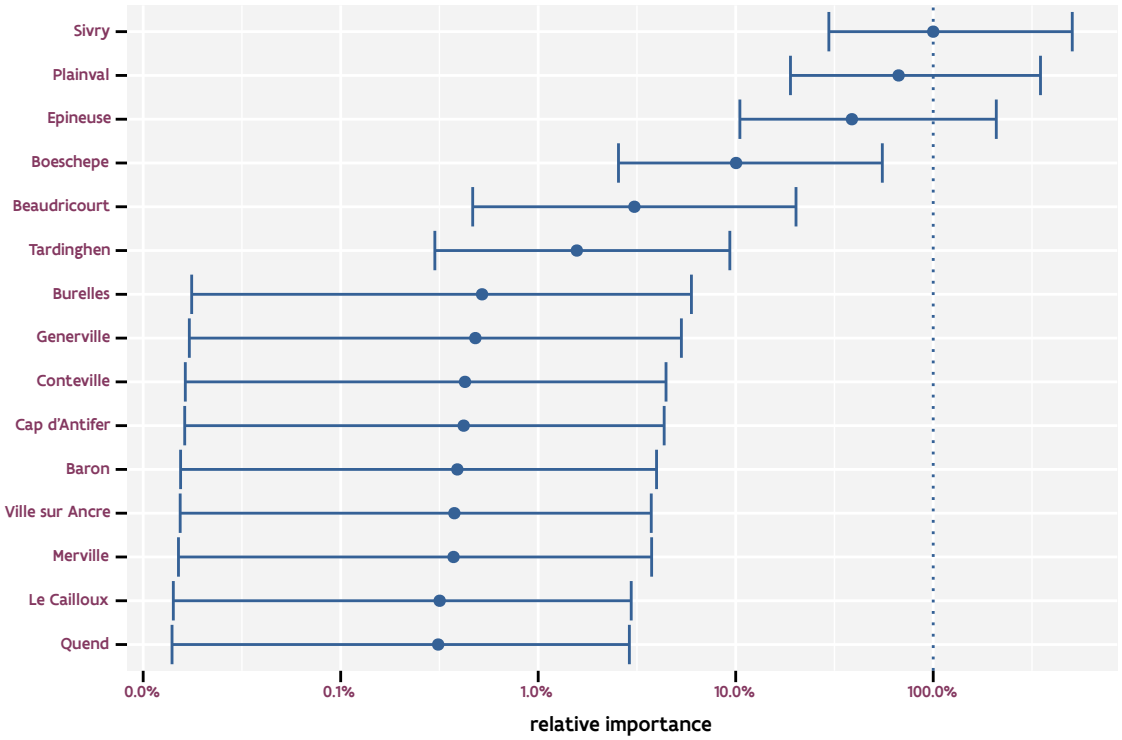

Figure 4.118: Relative importance per site for *Garrulus glandarius*.

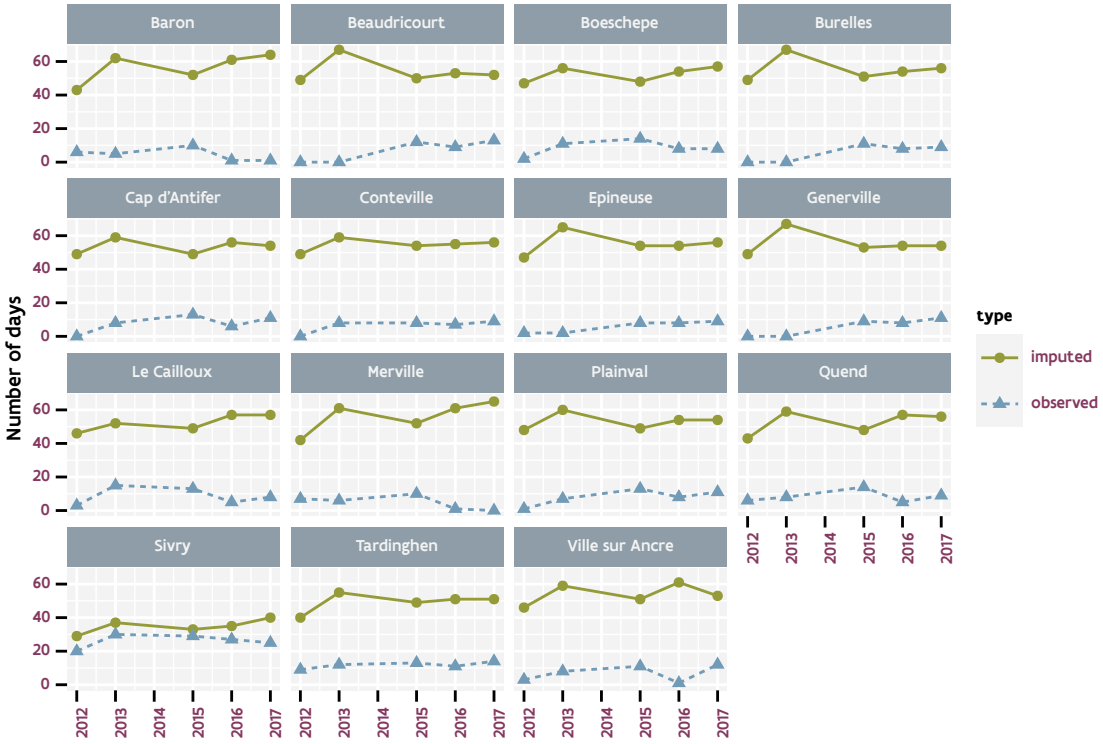

Figure 4.119: Number of days with observations per site and per year for *Garrulus glandarius*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

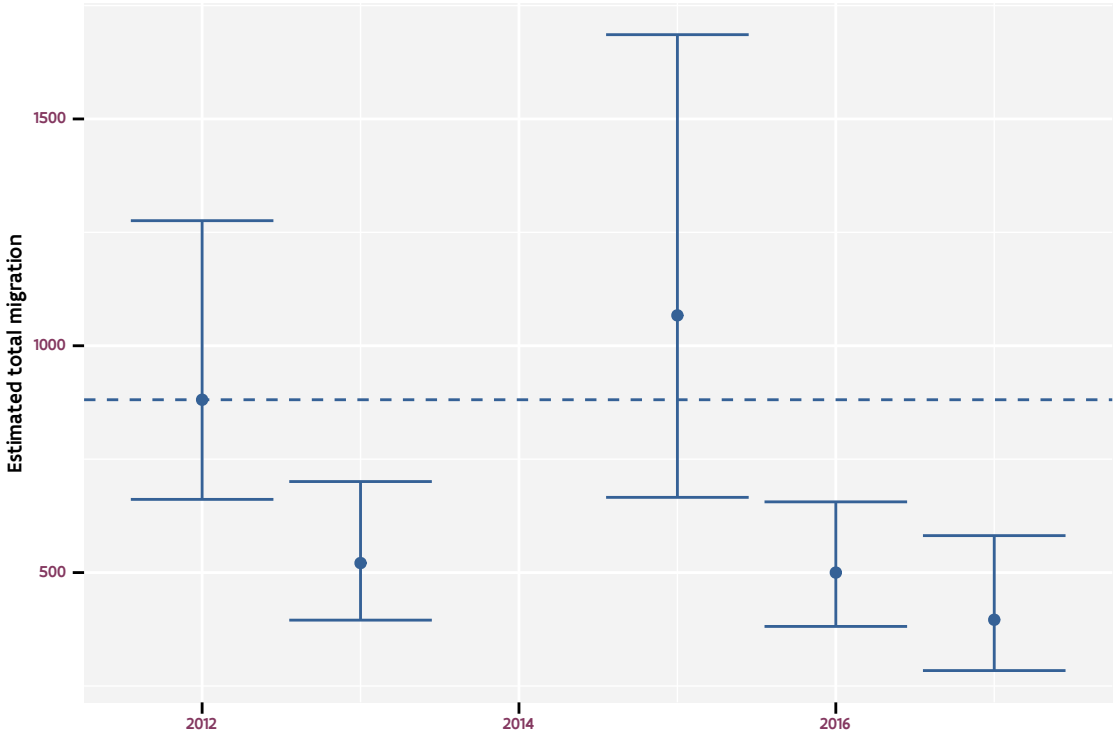

Figure 4.120: Imputed total of *Garrulus glandarius* during the migration period.

4.21 *CORVUS MONEDULA*

- English: jackdaw
- French: choucas des tours
- Dutch: kauw
- EURING: 15600

More information on *Corvus monedula*: https://www.gbif.org/species/6100954

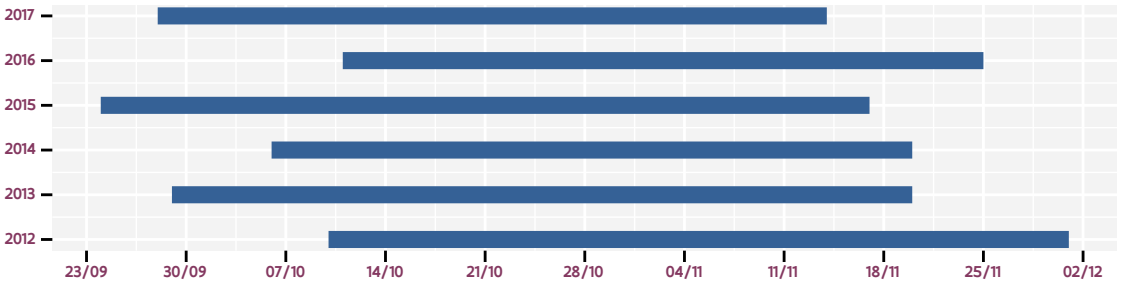

Figure 4.121: Migration periods used for *Corvus monedula*.

https://doi.org/10.21436/inbor.16917180

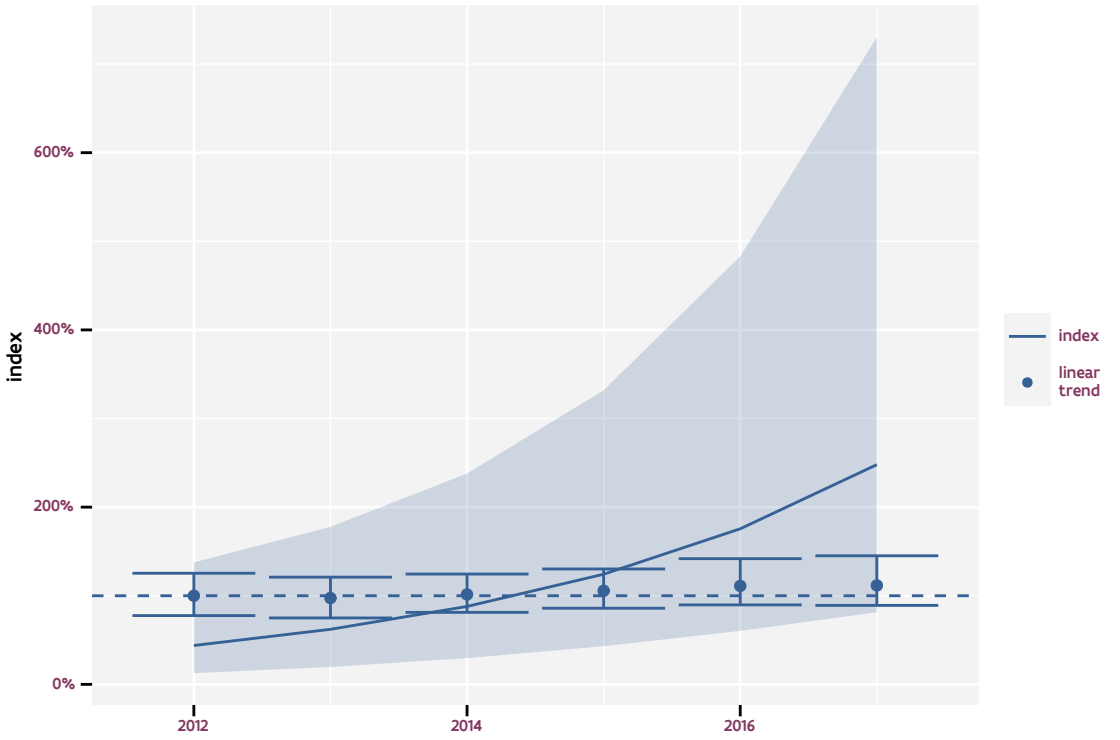

Figure 4.122: Indices and linear trend for *Corvus monedula*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

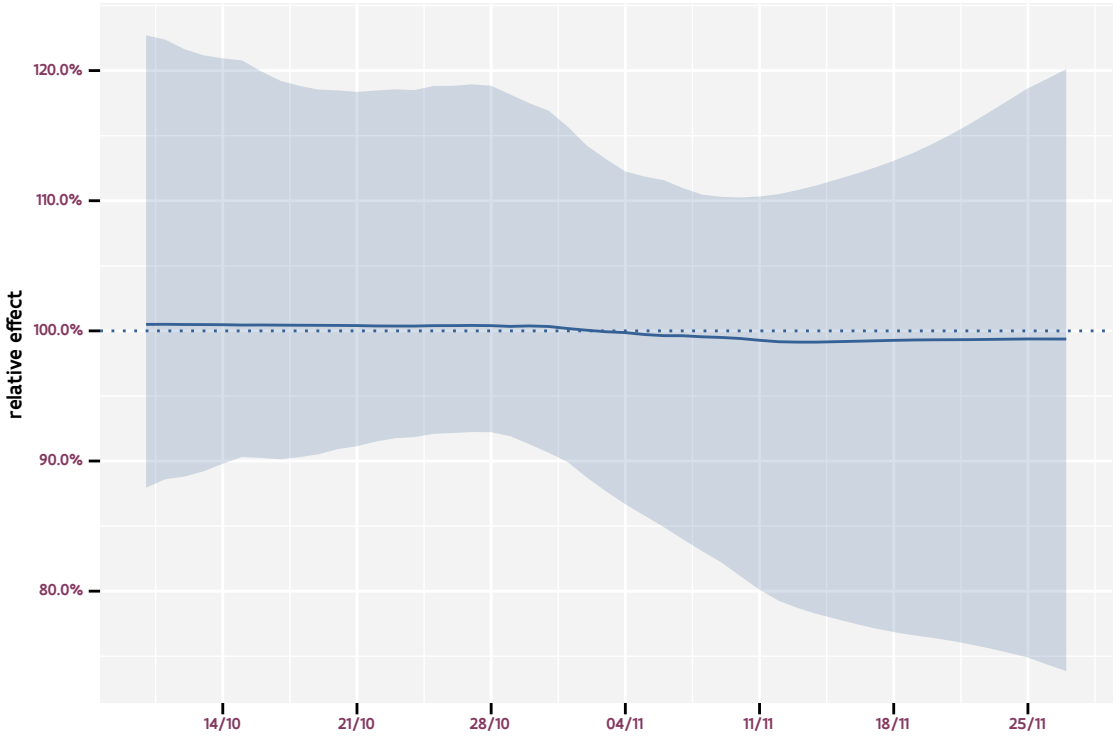

Figure 4.123: Seasonal pattern for *Corvus monedula*.

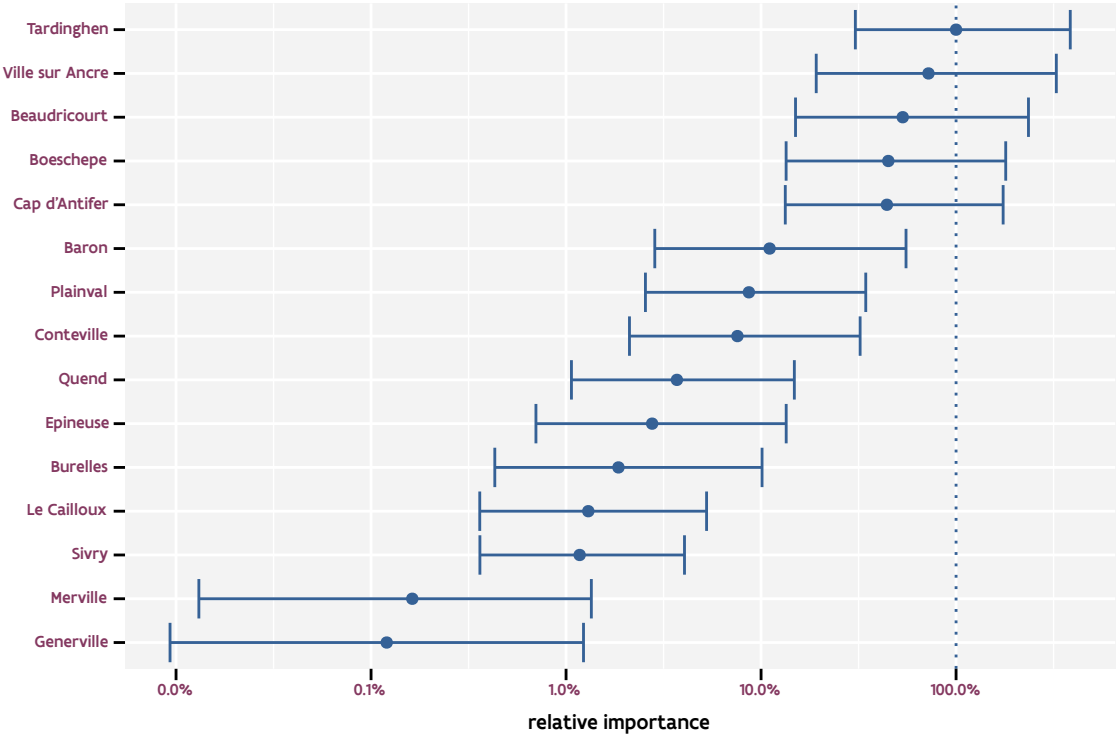

Figure 4.124: Relative importance per site for *Corvus monedula*.

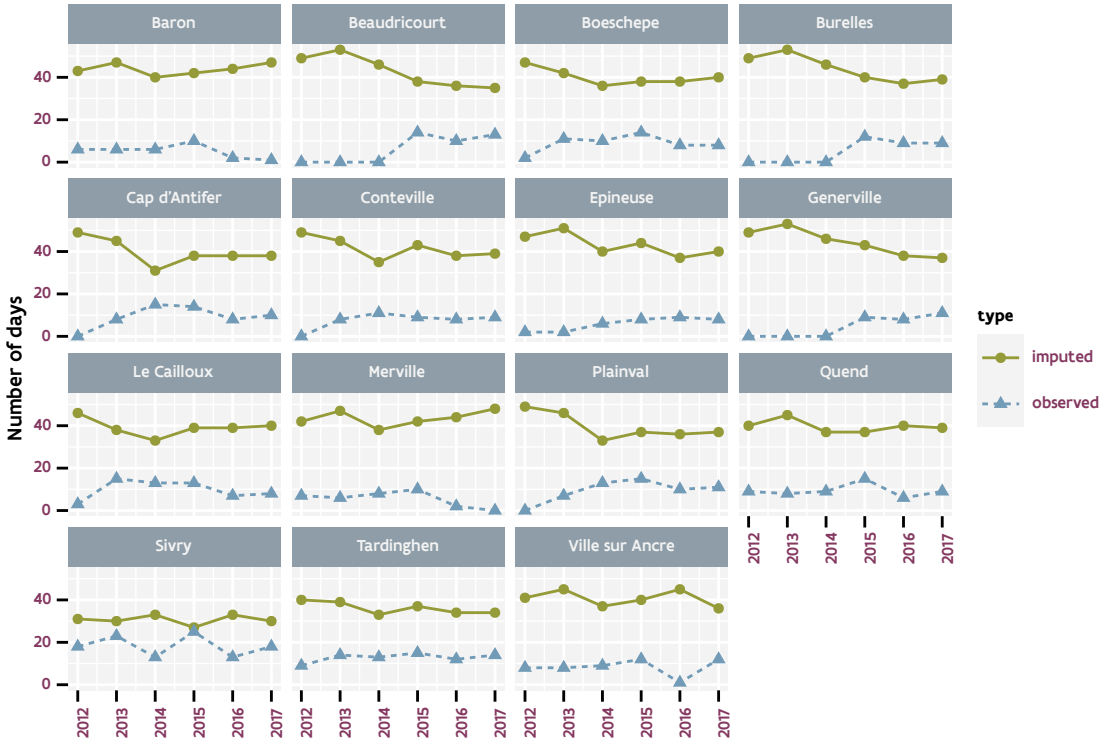

Figure 4.125: Number of days with observations per site and per year for *Corvus monedula*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

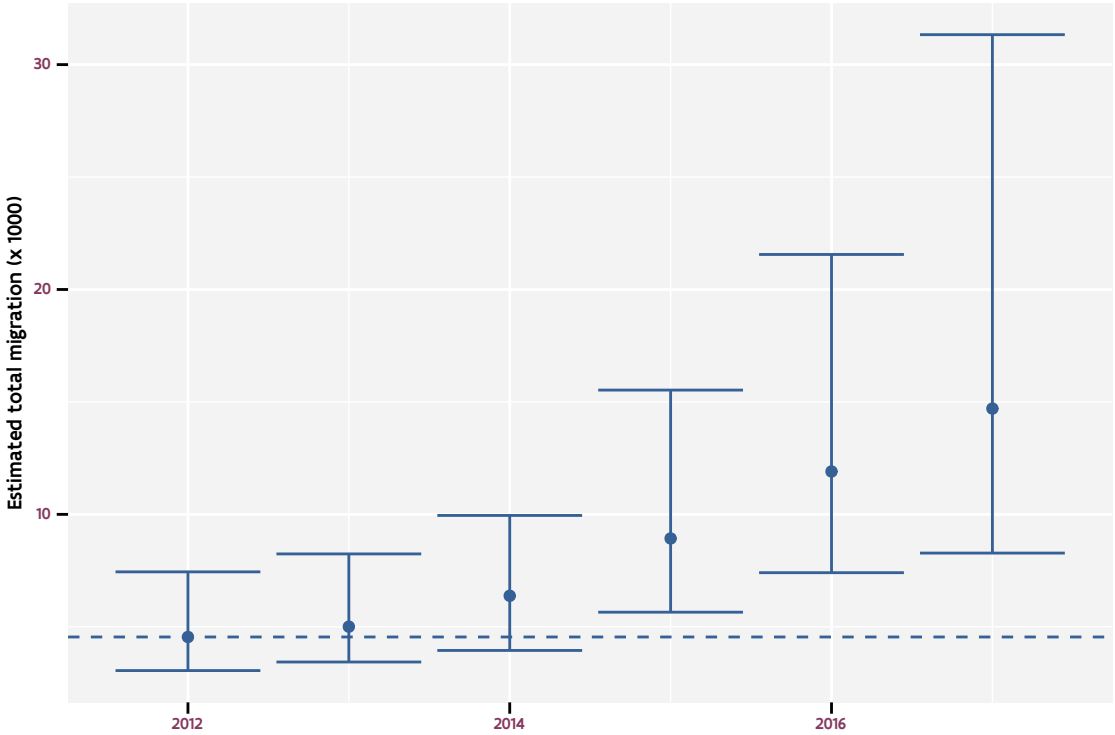

Figure 4.126: Imputed total of *Corvus monedula* during the migration period.

4.22 *CORVUS FRUGILEGUS*

- English: rook
- French: corbeau freux
- Dutch: roek
- EURING: 15630

More information on *Corvus frugilegus*: https://www.gbif.org/species/2482513

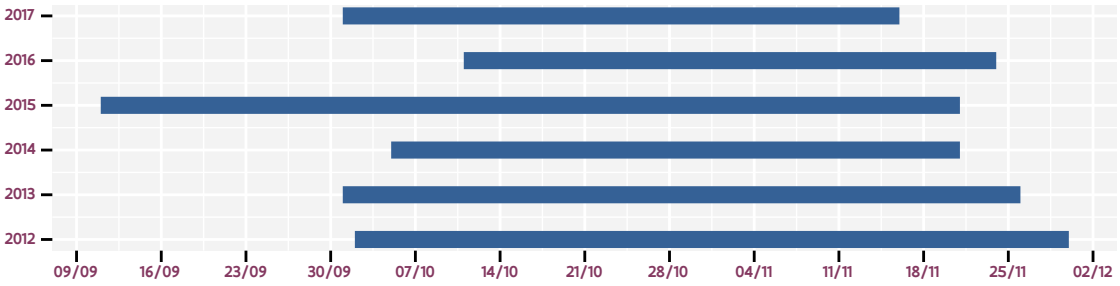

Figure 4.127: Migration periods used for *Corvus frugilegus*.

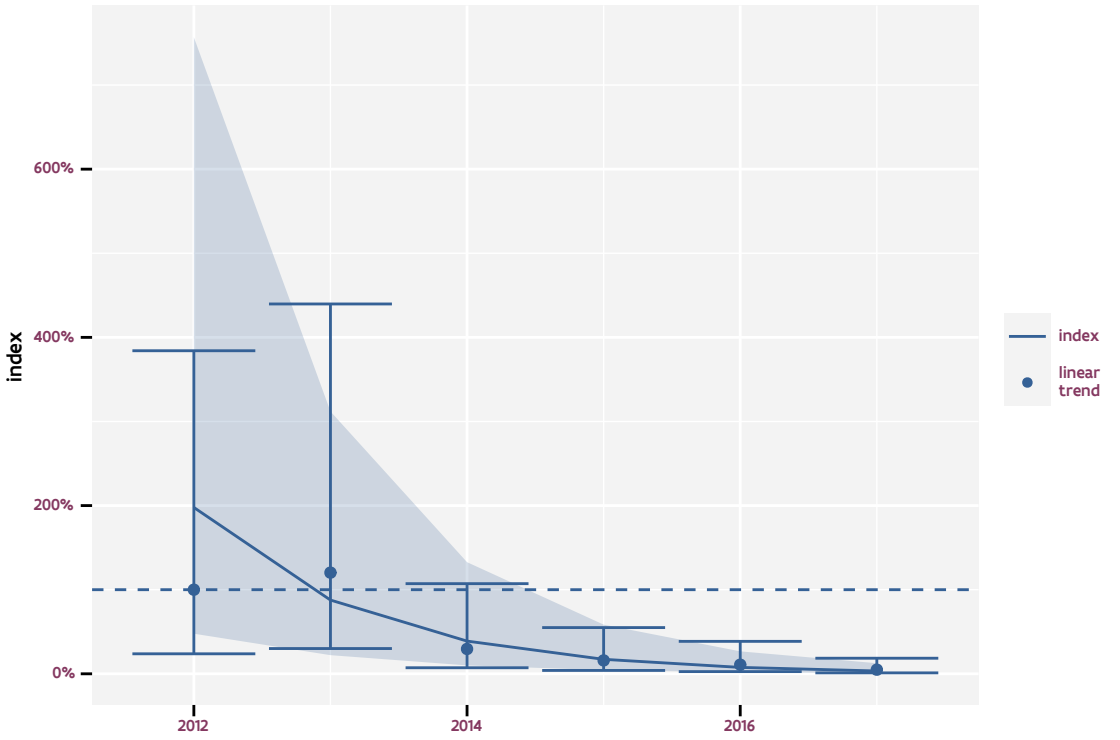

Figure 4.128: Indices and linear trend for *Corvus frugilegus*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

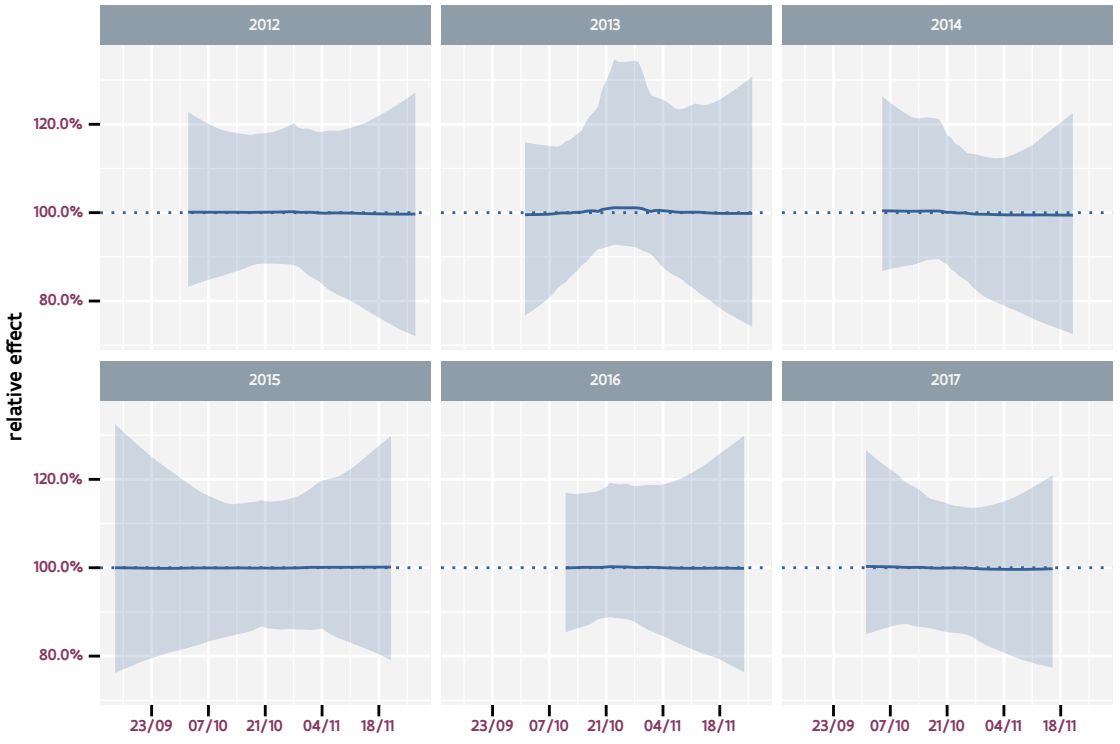

Figure 4.129: Seasonal pattern for *Corvus frugilegus*.

https://doi.org/10.21436/inbor.16917180

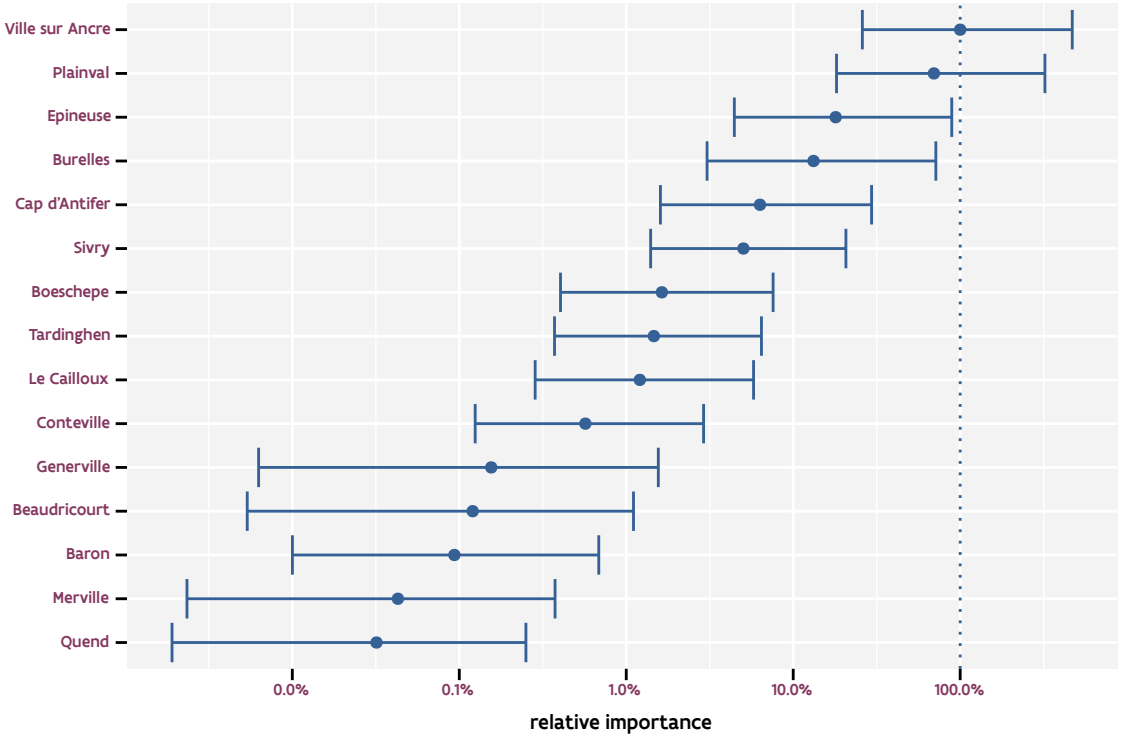

Figure 4.130: Relative importance per site for *Corvus frugilegus*.

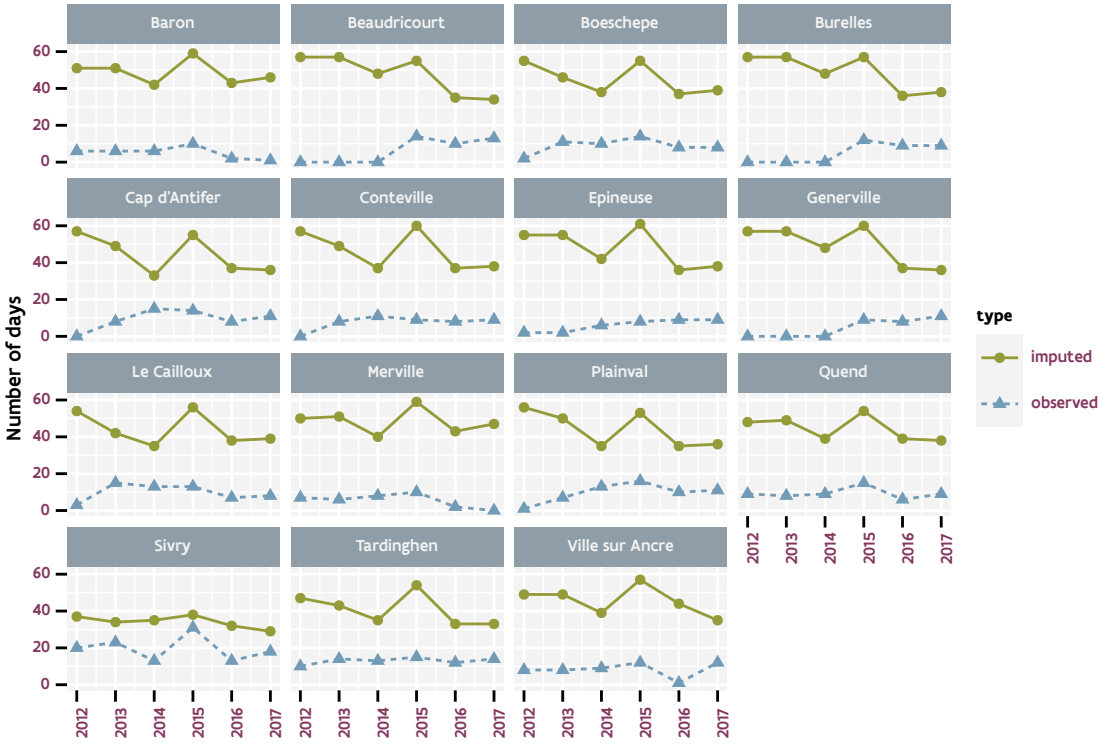

Figure 4.131: Number of days with observations per site and per year for *Corvus frugilegus*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

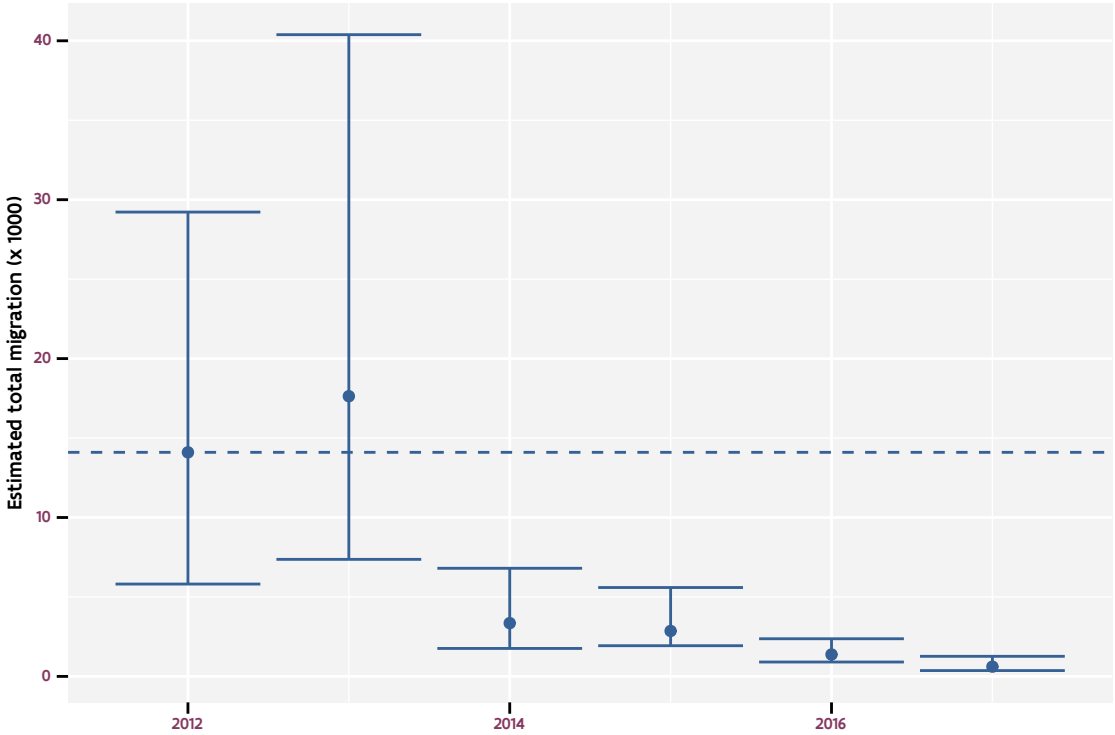

Figure 4.132: Imputed total of *Corvus frugilegus* during the migration period.

4.23 *CORVUS CORONE*

- English: carrion crow
- French: corneille noire
- Dutch: zwarte kraai
- EURING: 15670

More information on *Corvus corone*: https://www.gbif.org/species/9409796

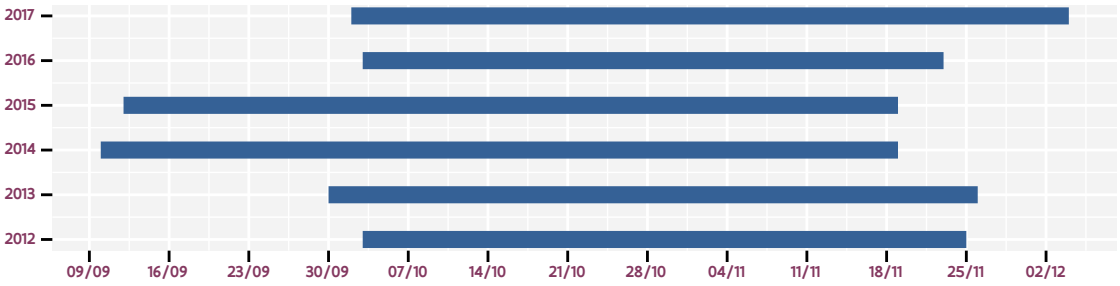

Figure 4.133: Migration periods used for *Corvus corone*.

https://doi.org/10.21436/inbor.16917180

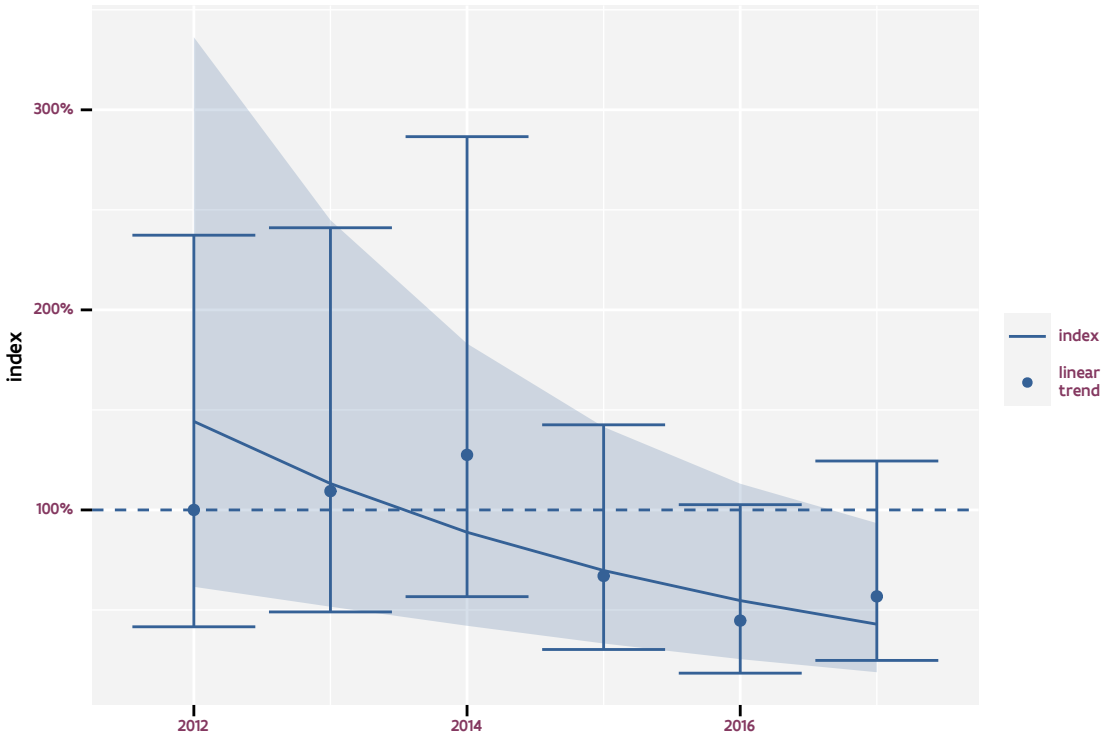

Figure 4.134: Indices and linear trend for *Corvus corone*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

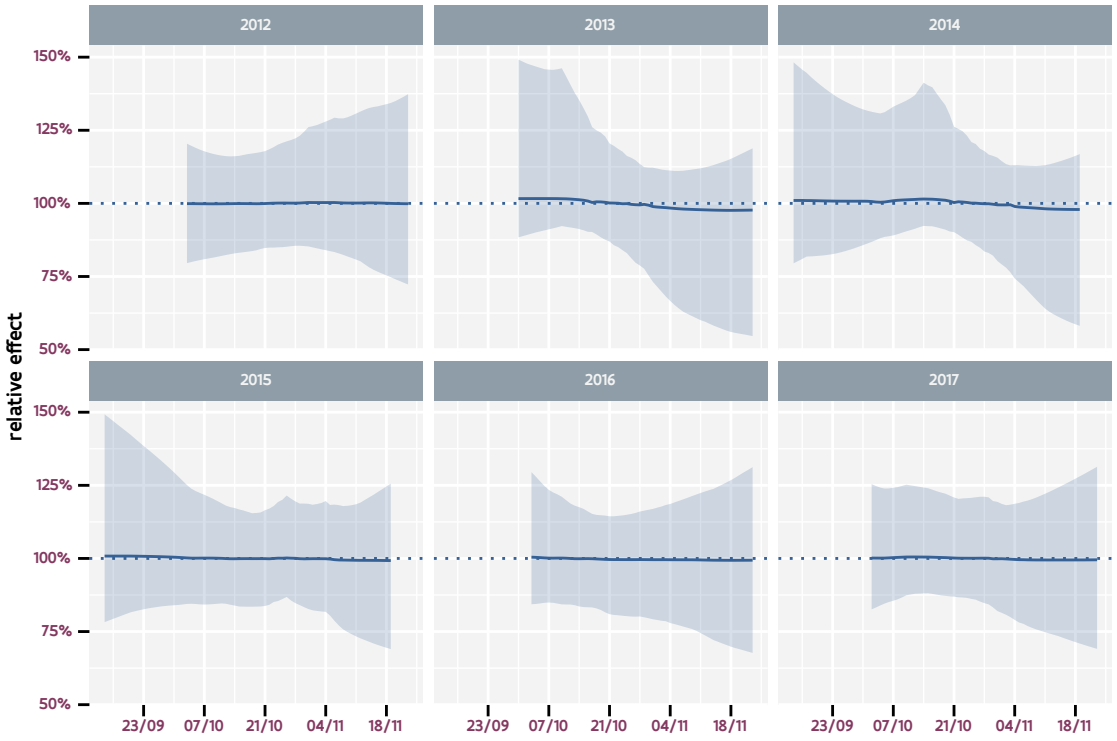

Figure 4.135: Seasonal pattern for *Corvus corone*.

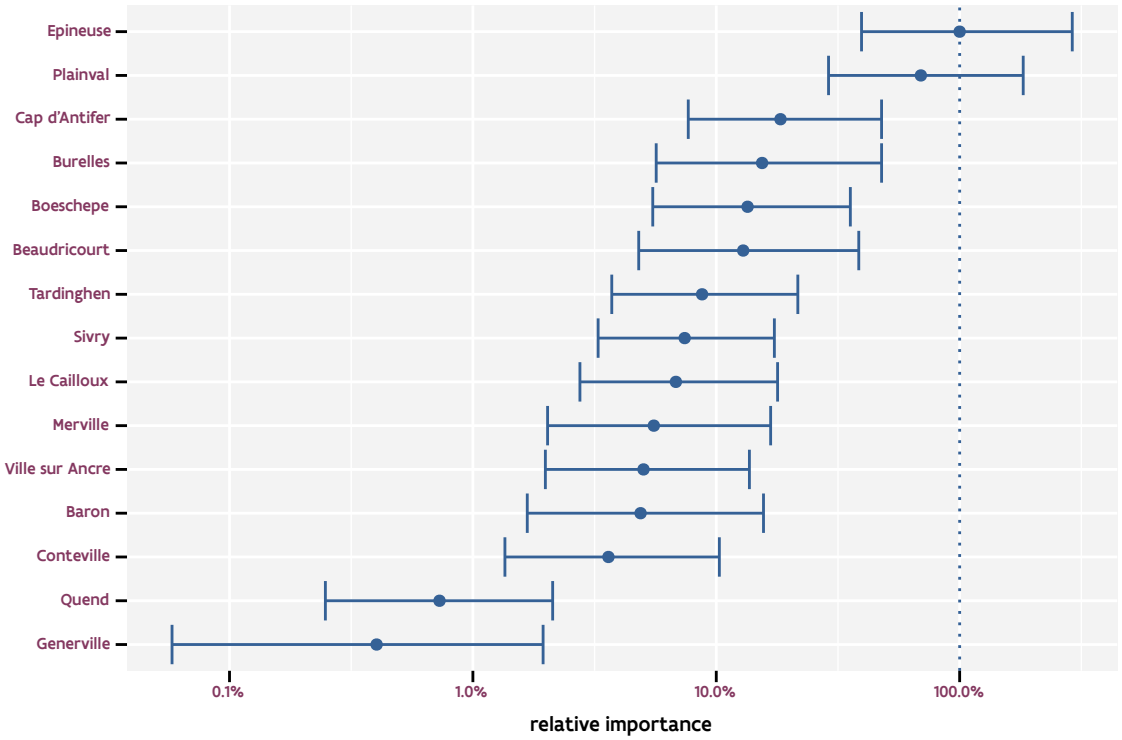

Figure 4.136: Relative importance per site for *Corvus corone*.

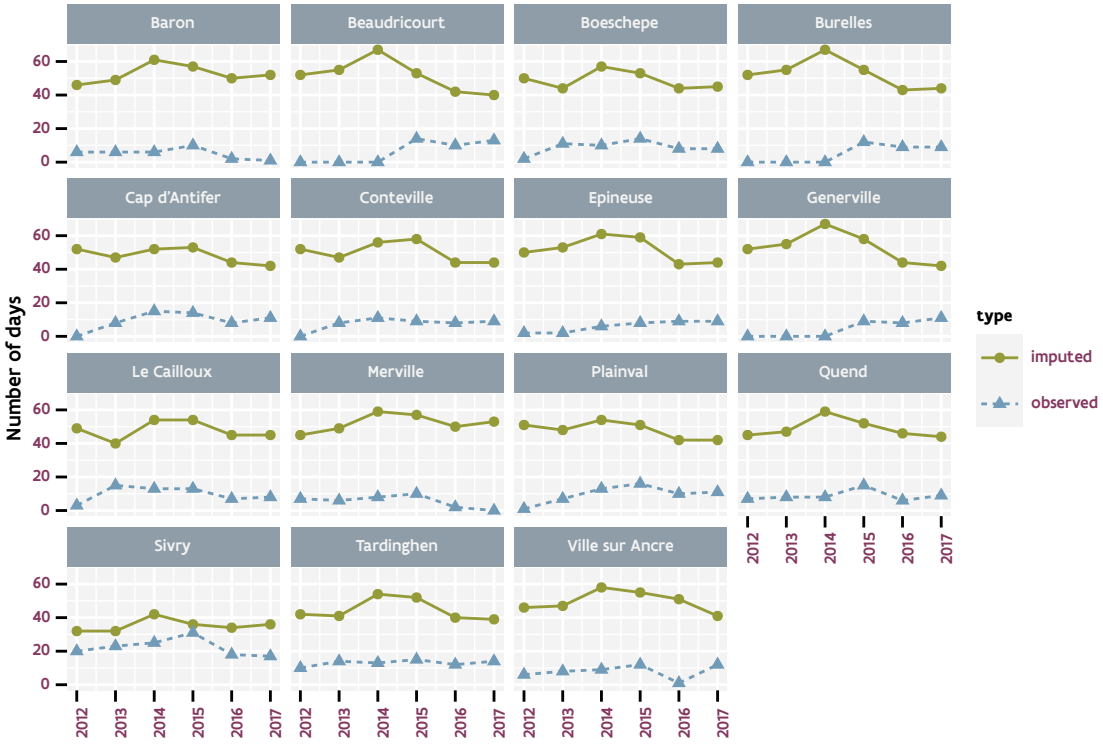

Figure 4.137: Number of days with observations per site and per year for *Corvus corone*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

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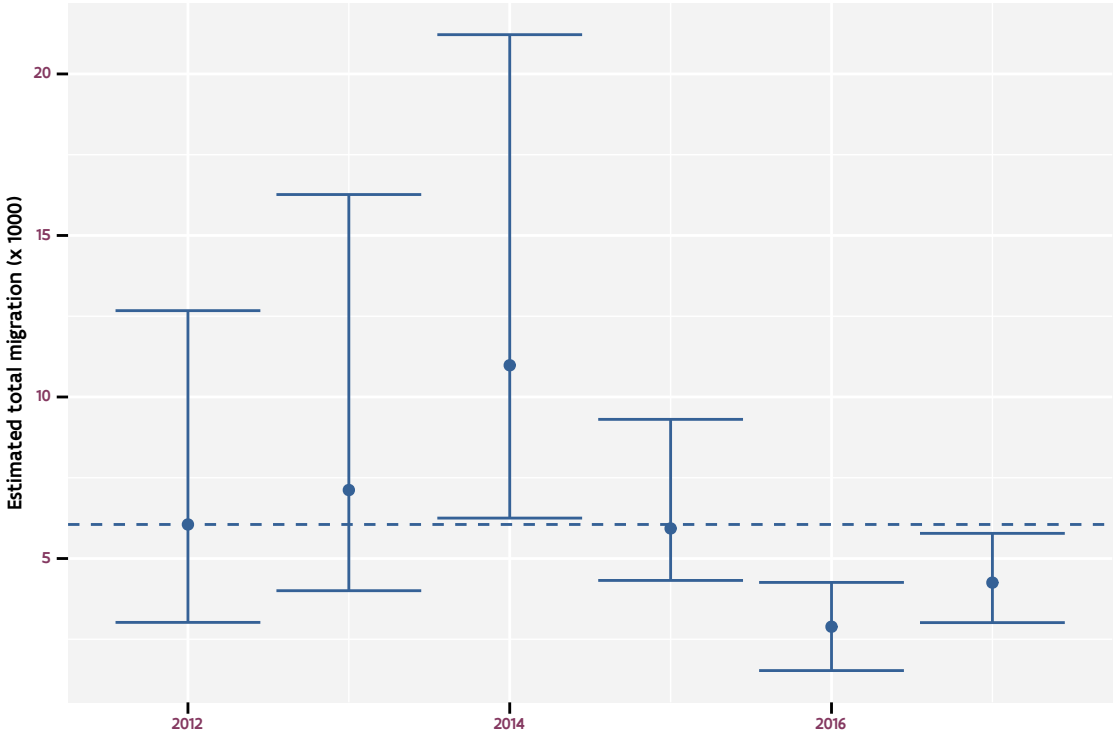

Figure 4.138: Imputed total of *Corvus corone* during the migration period.

4.24 *STURNUS VULGARIS*

- English: starling
- French: étourneau sansonnet
- Dutch: spreeuw
- EURING: 15820

More information on *Sturnus vulgaris*: https://www.gbif.org/species/9809229

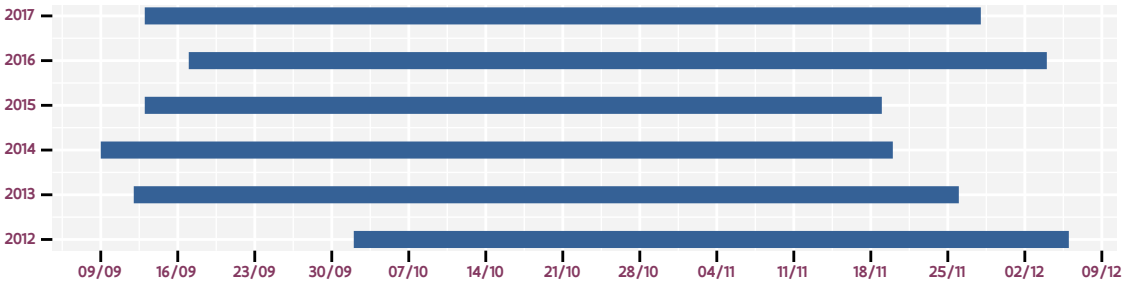

Figure 4.139: Migration periods used for *Sturnus vulgaris*.

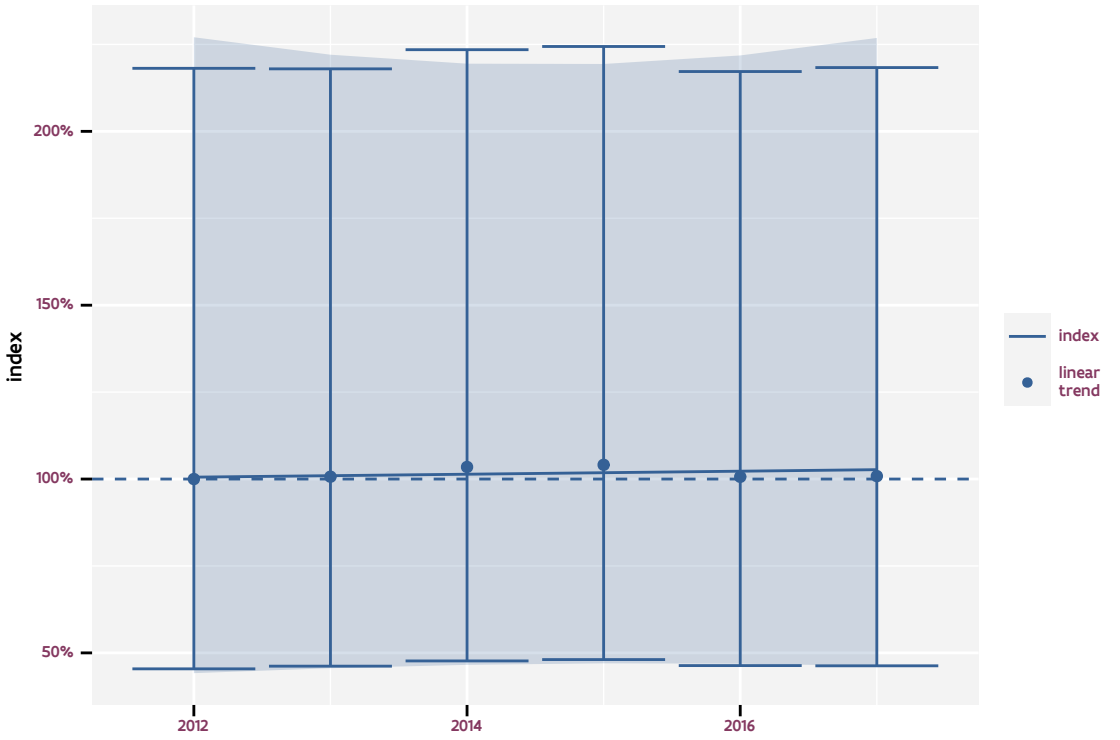

Figure 4.140: Indices and linear trend for *Sturnus vulgaris*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

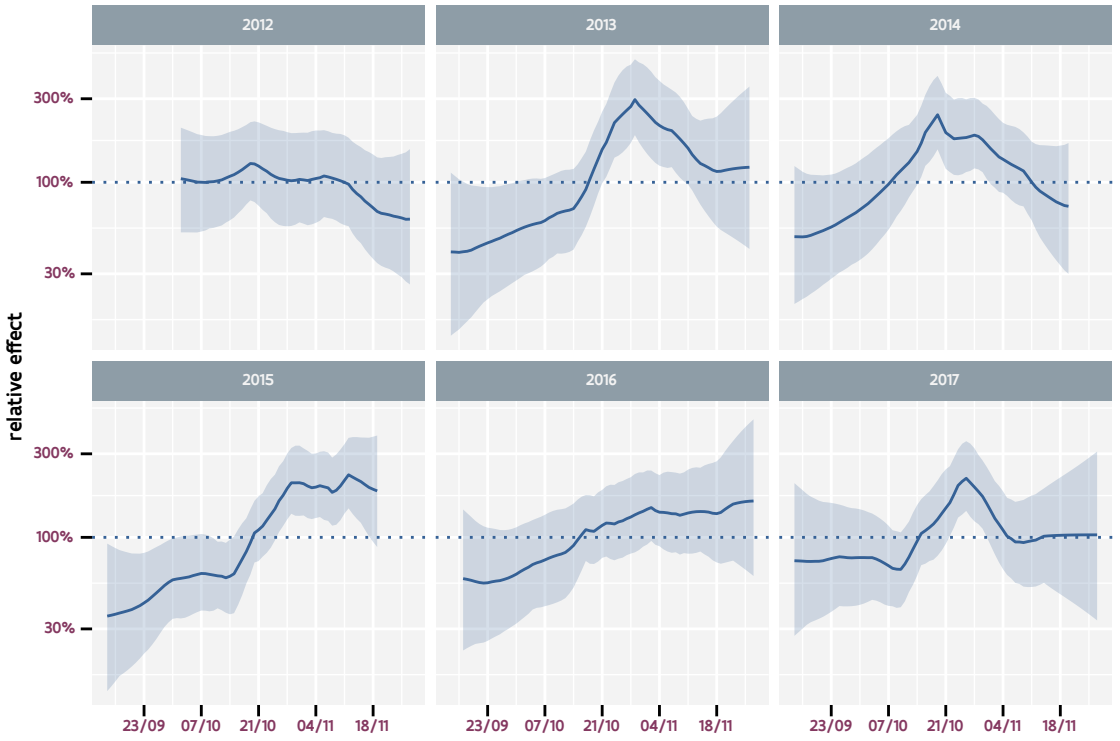

Figure 4.141: Seasonal pattern for *Sturnus vulgaris*.

https://doi.org/10.21436/inbor.16917180

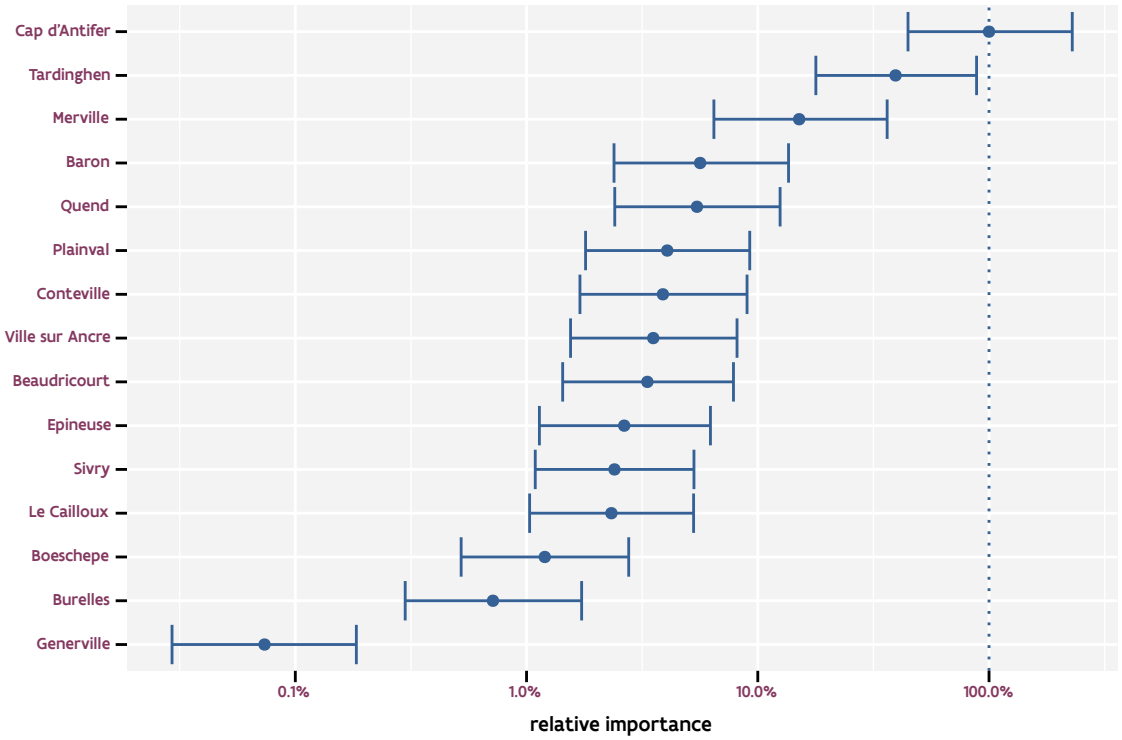

Figure 4.142: Relative importance per site for *Sturnus vulgaris*.

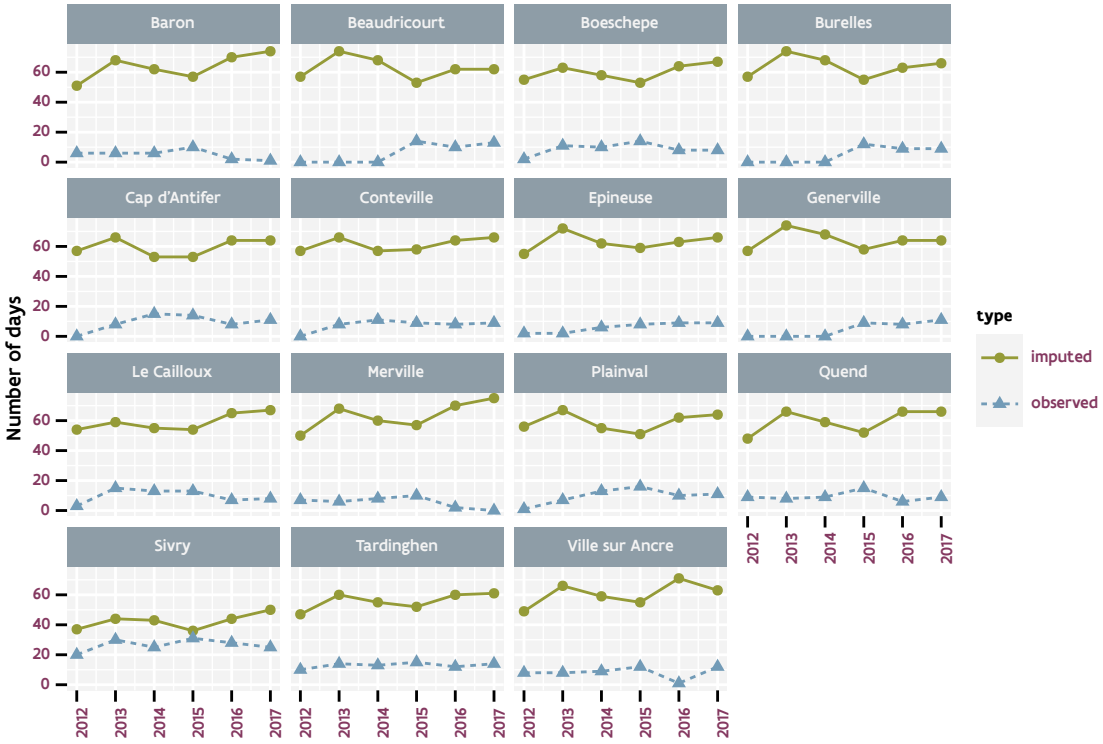

Figure 4.143: Number of days with observations per site and per year for *Sturnus vulgaris*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

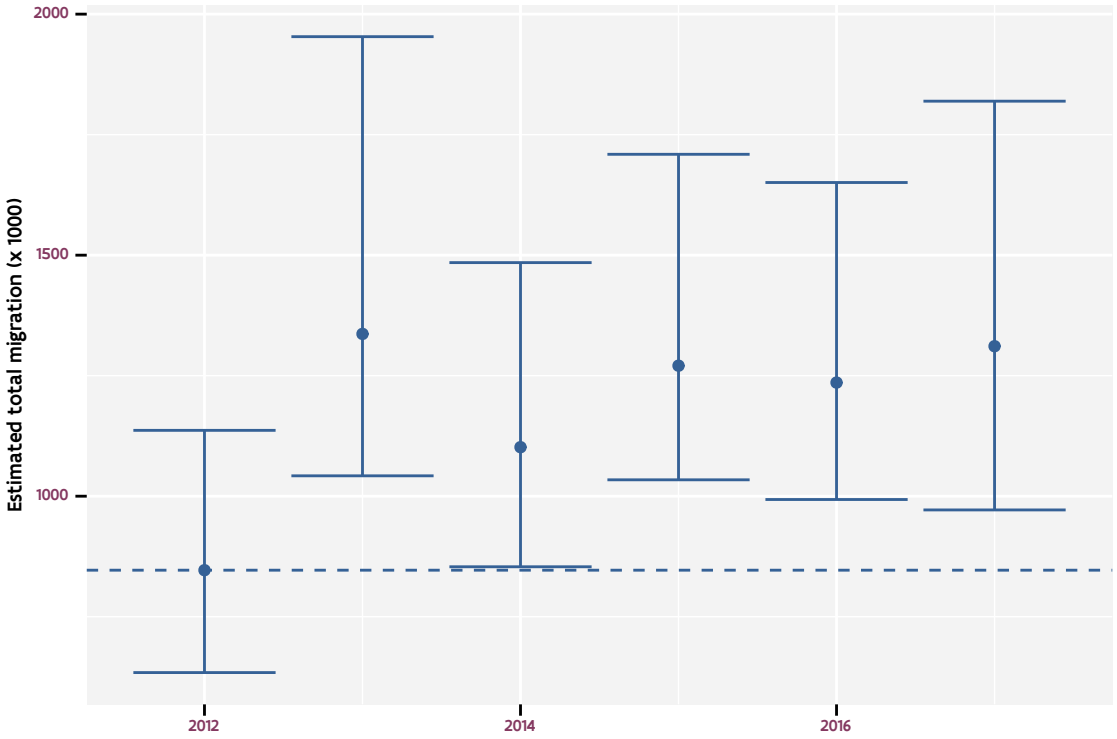

Figure 4.144: Imputed total of *Sturnus vulgaris* during the migration period.

4.25 *FRINGILLA COELEBS*

- English: chaffinch
- French: pinson des arbres
- Dutch: vink
- EURING: 16360

More information on *Fringilla coelebs*: https://www.gbif.org/species/2494422

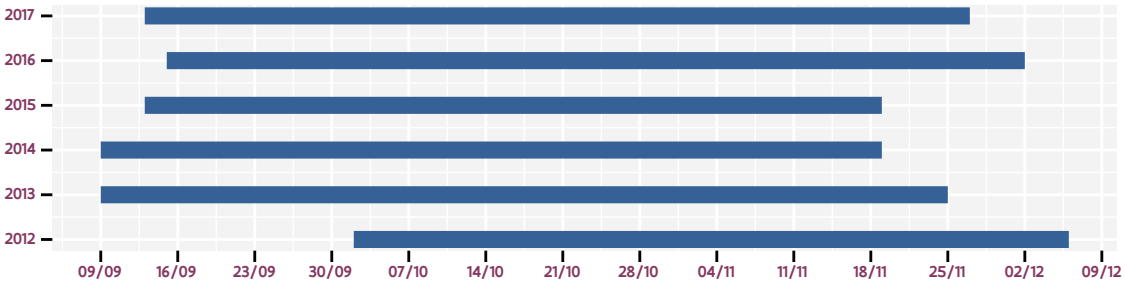

Figure 4.145: Migration periods used for *Fringilla coelebs*.

https://doi.org/10.21436/inbor.16917180

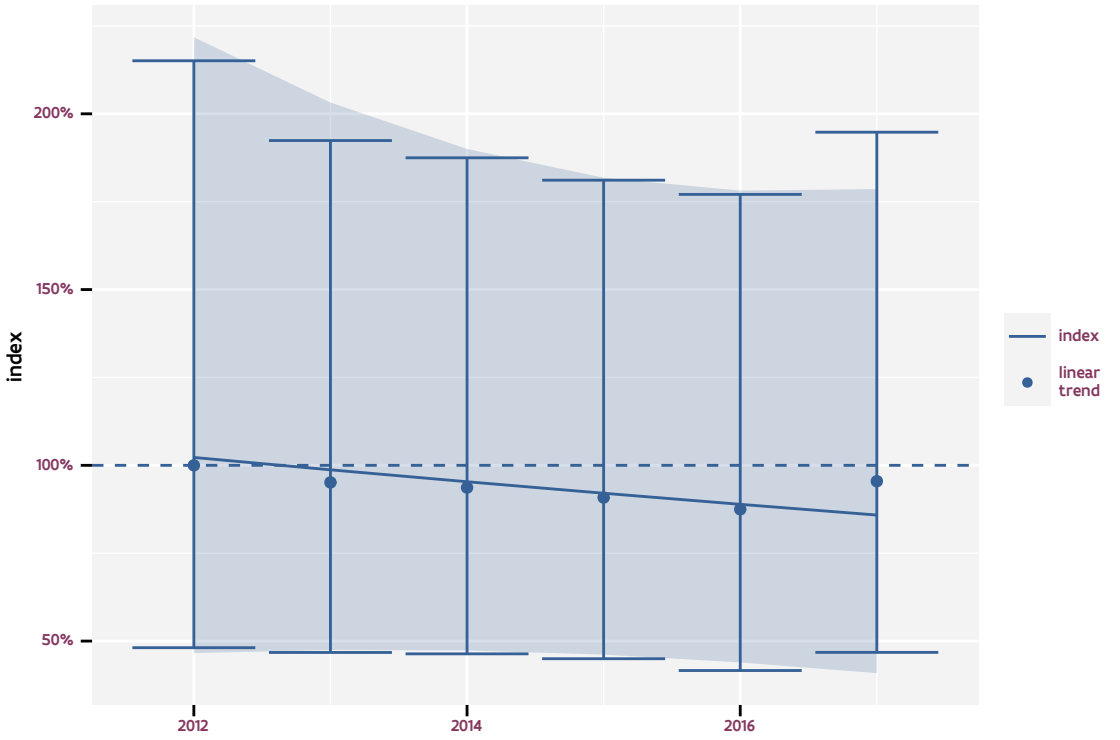

Figure 4.146: Indices and linear trend for *Fringilla coelebs*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

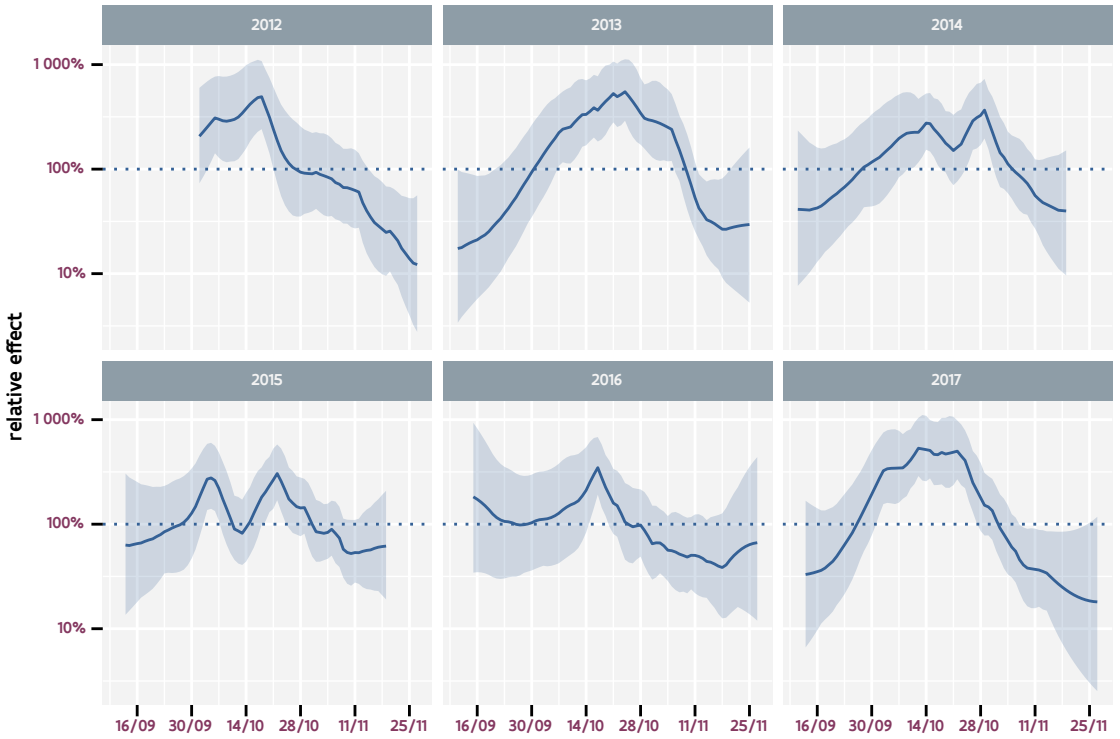

Figure 4.147: Seasonal pattern for *Fringilla coelebs*.

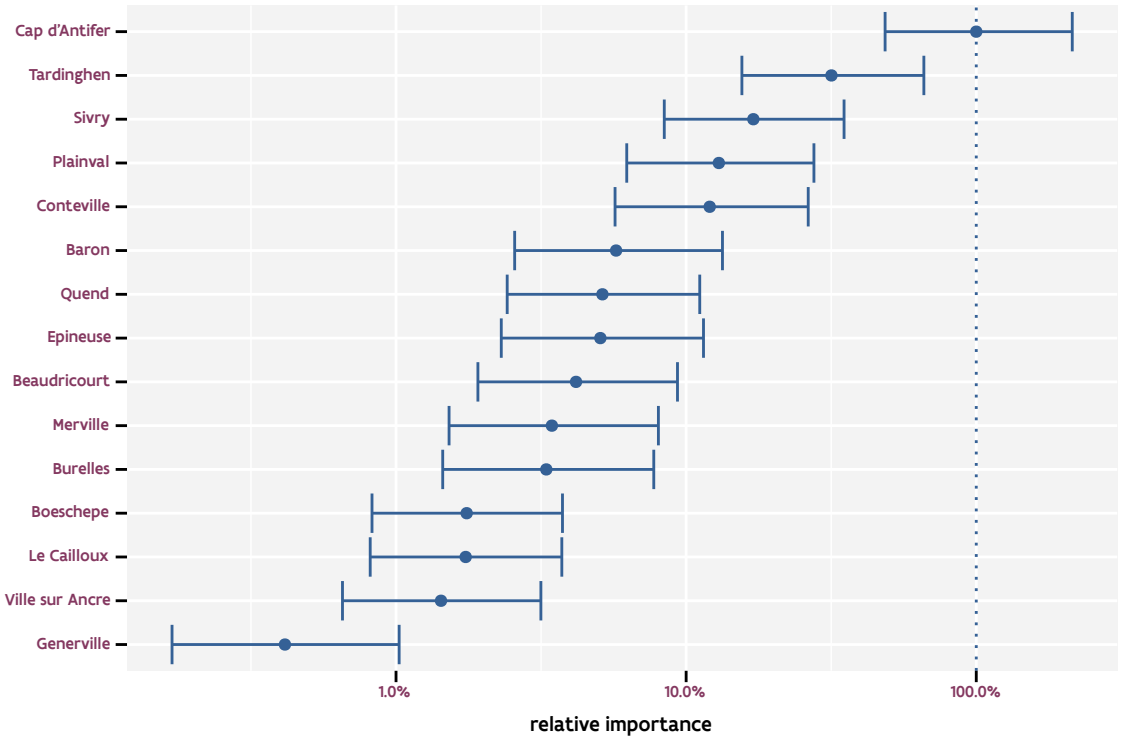

Figure 4.148: Relative importance per site for *Fringilla coelebs*.

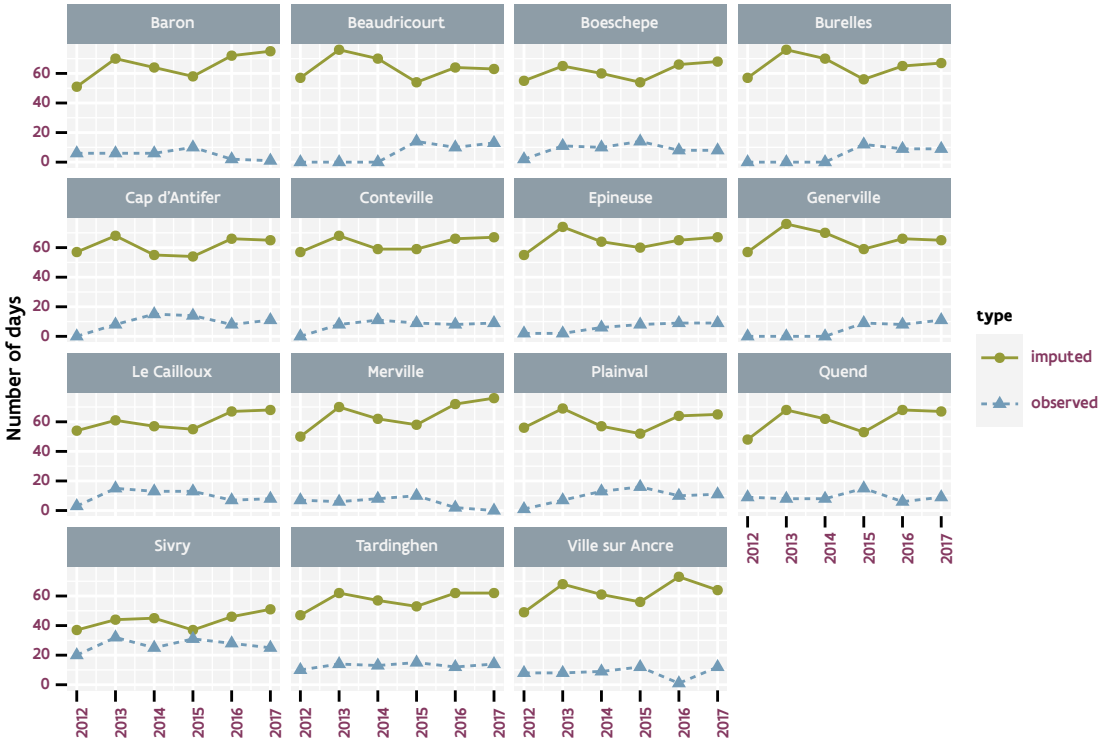

Figure 4.149: Number of days with observations per site and per year for *Fringilla coelebs*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

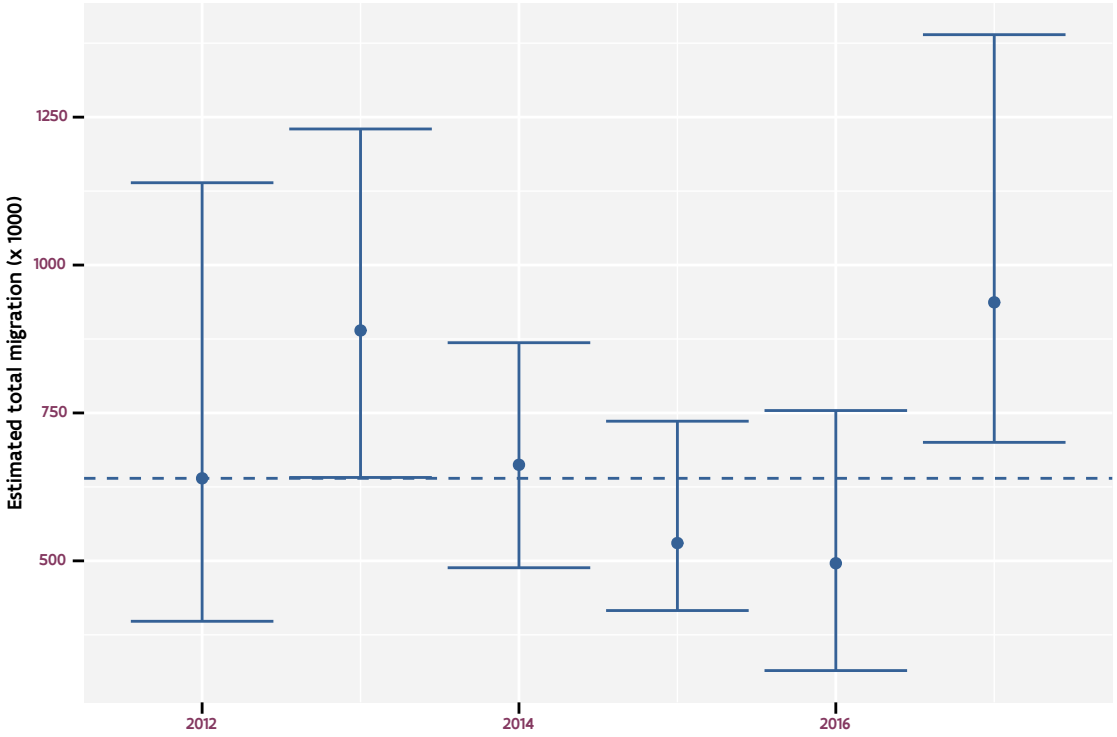

Figure 4.150: Imputed total of *Fringilla coelebs* during the migration period.

4.26 *FRINGILLA MONTIFRINGILLA*

- English: brambling
- French: pinson du nord
- Dutch: keep
- EURING: 16380

More information on *Fringilla montifringilla*: https://www.gbif.org/species/2494441

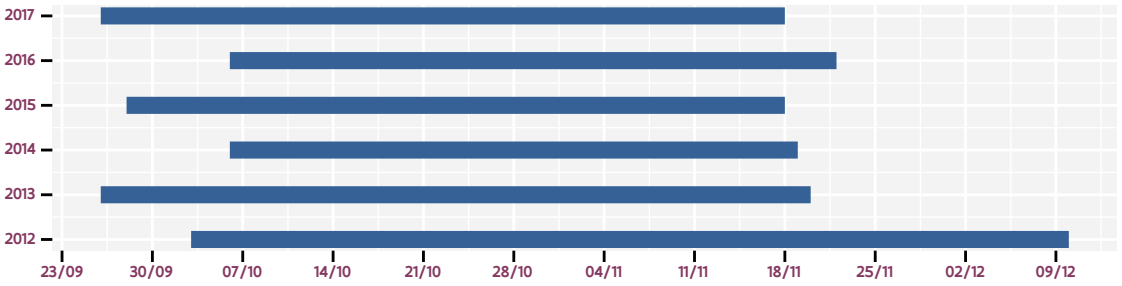

Figure 4.151: Migration periods used for *Fringilla montifringilla*.

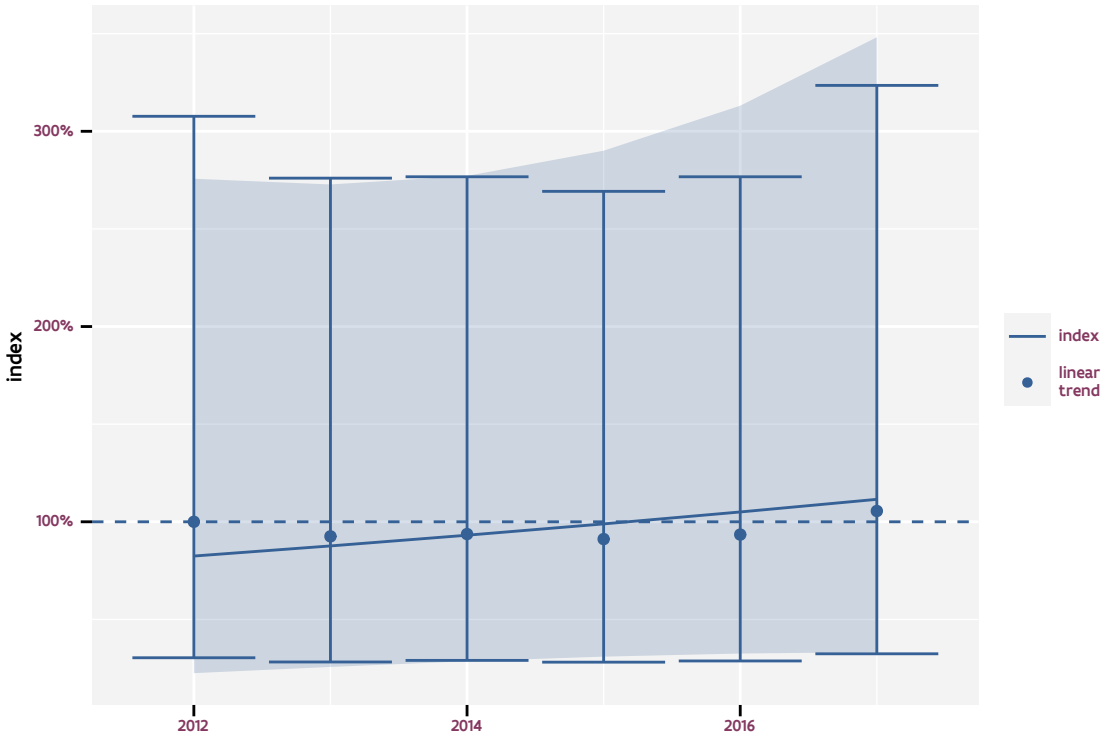

Figure 4.152: Indices and linear trend for *Fringilla montifringilla*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

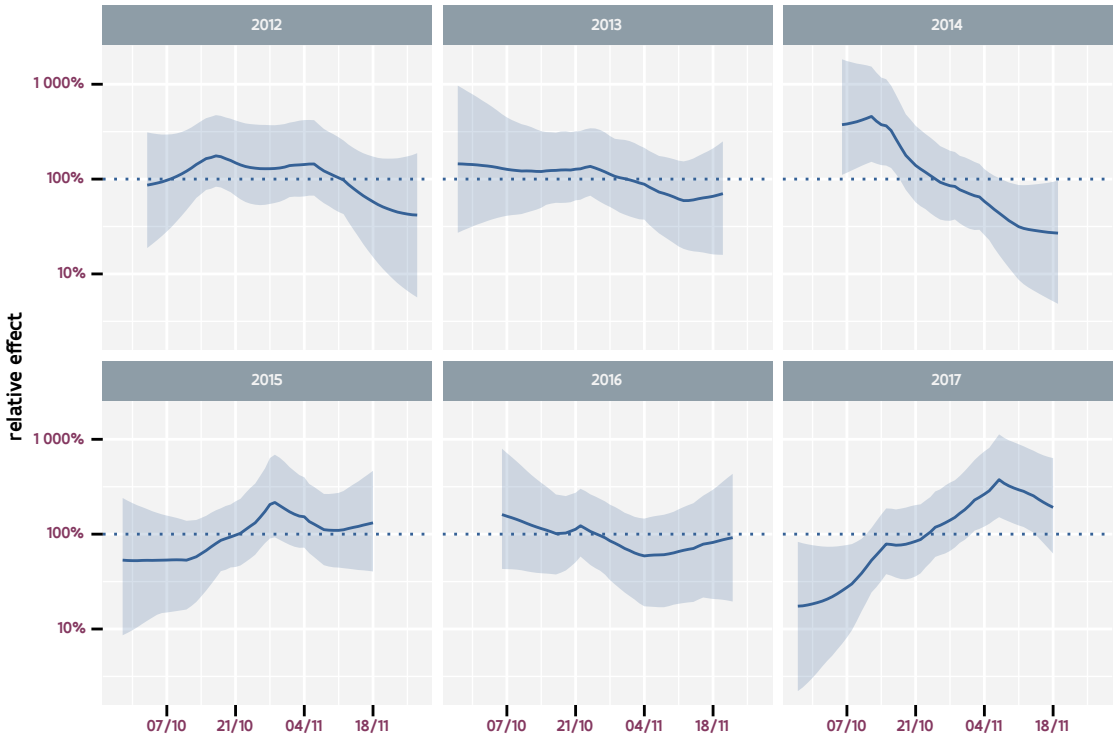

Figure 4.153: Seasonal pattern for *Fringilla montifringilla*.

https://doi.org/10.21436/inbor.16917180

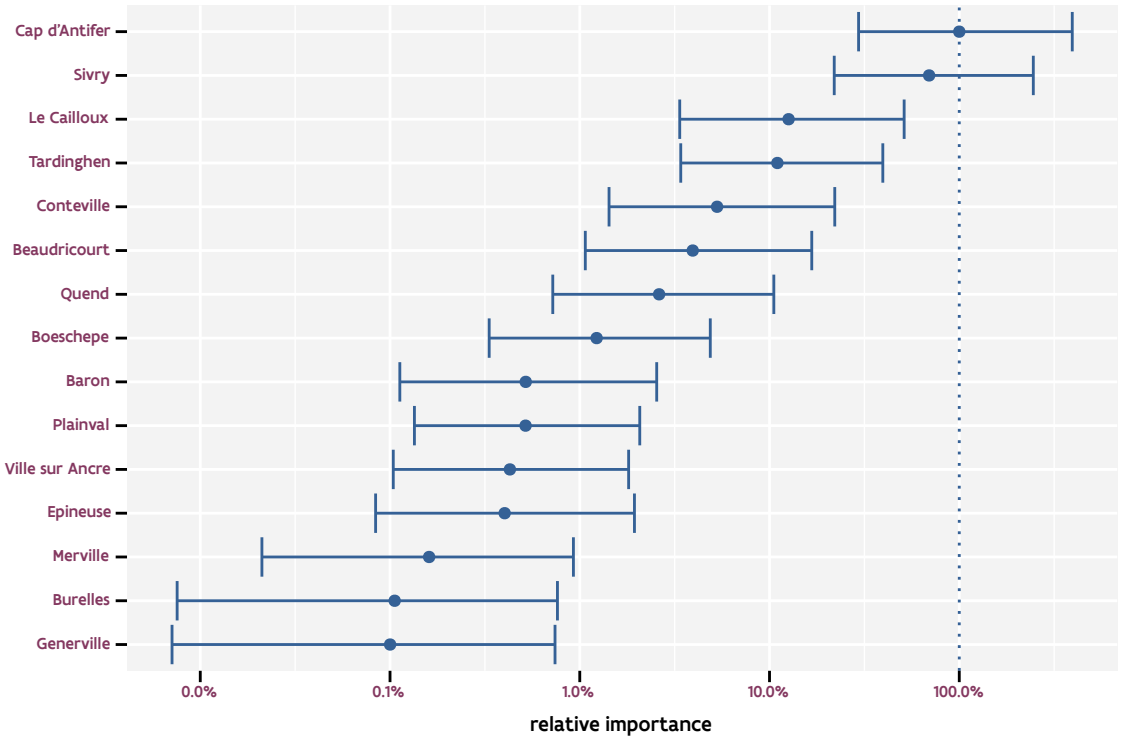

Figure 4.154: Relative importance per site for *Fringilla montifringilla*.

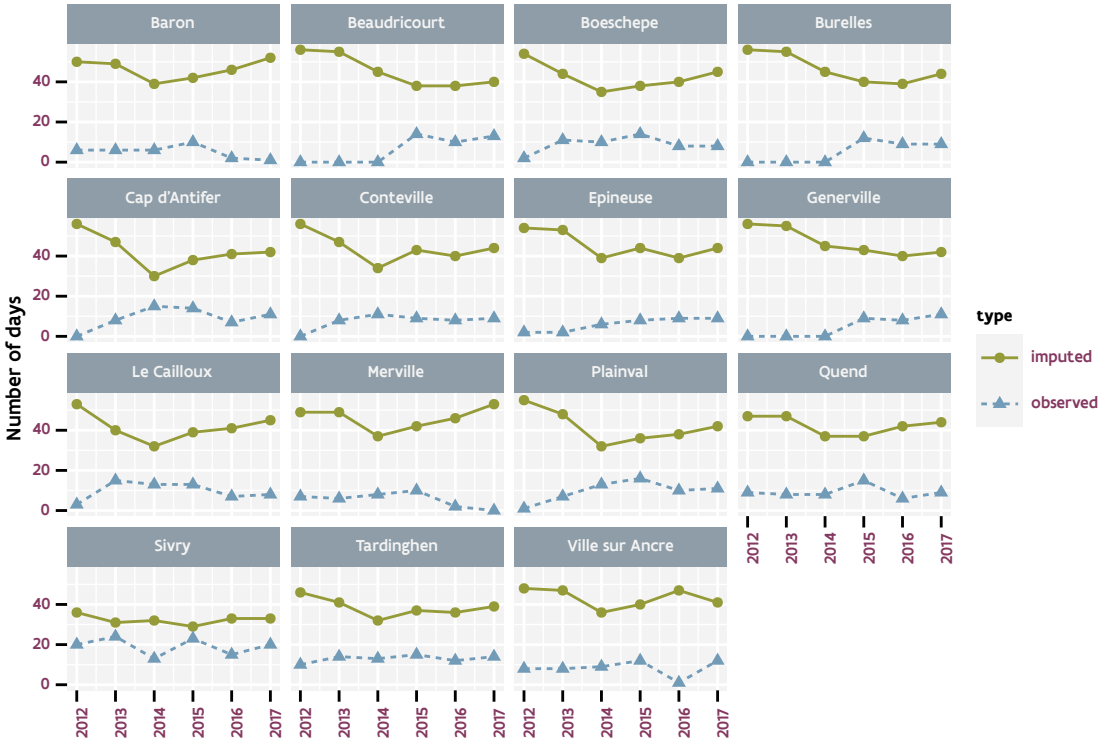

Figure 4.155: Number of days with observations per site and per year for *Fringilla montifringilla*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

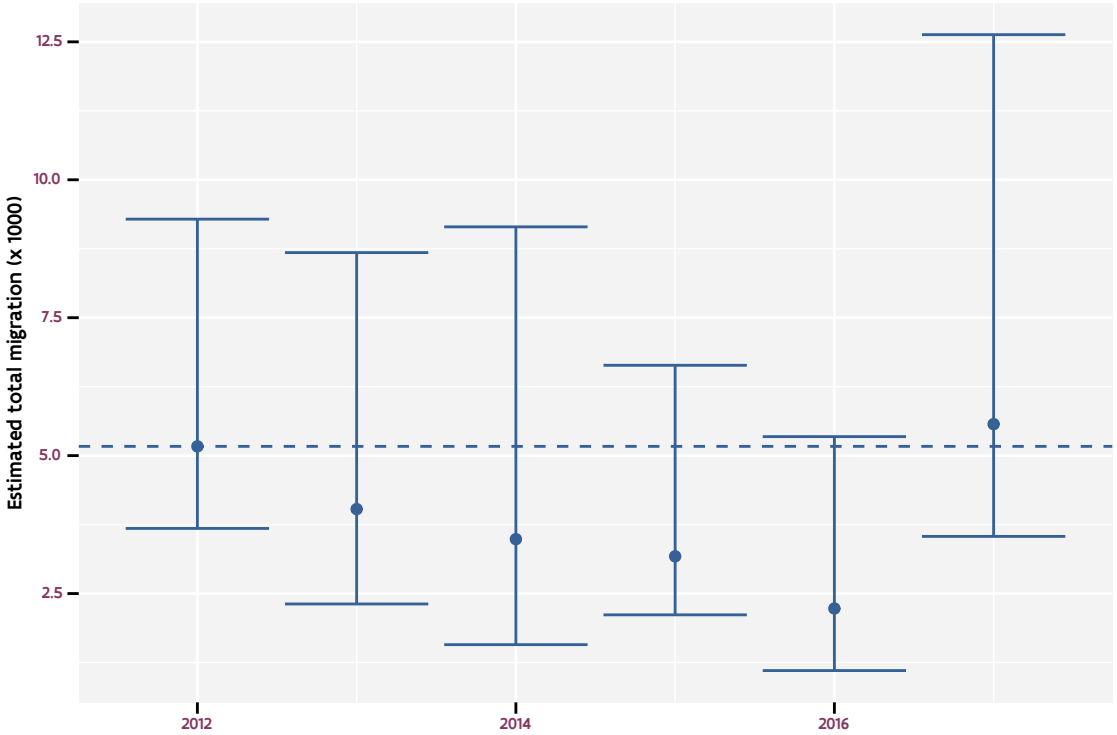

Figure 4.156: Imputed total of *Fringilla montifringilla* during the migration period.

4.27 *CHLORIS CHLORIS*

- English: European greenfinch
- French: verdier d'Europe
- Dutch: Groenling
- EURING: 16490

More information on *Chloris chloris*: https://www.gbif.org/species/5845582

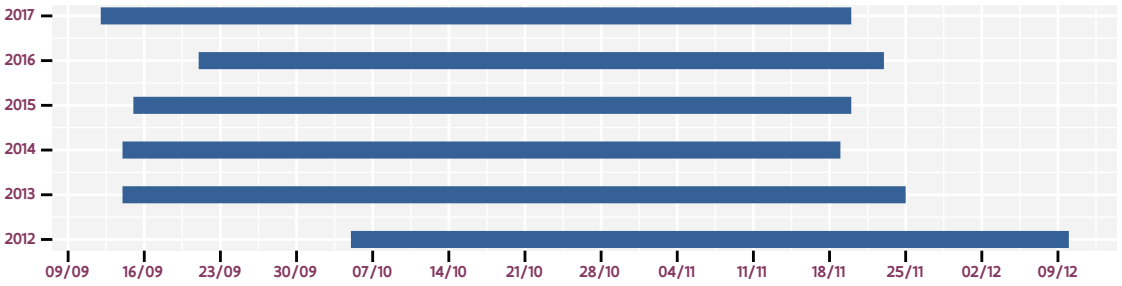

Figure 4.157: Migration periods used for *Chloris chloris*.

https://doi.org/10.21436/inbor.16917180

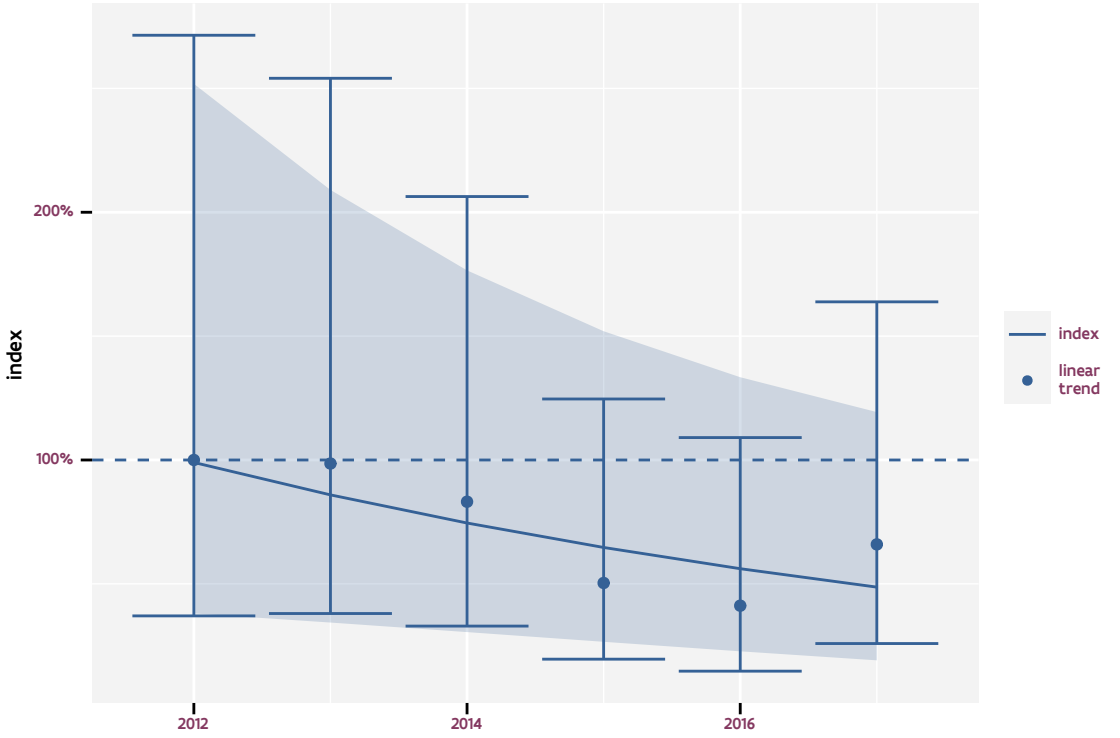

Figure 4.158: Indices and linear trend for *Chloris chloris*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

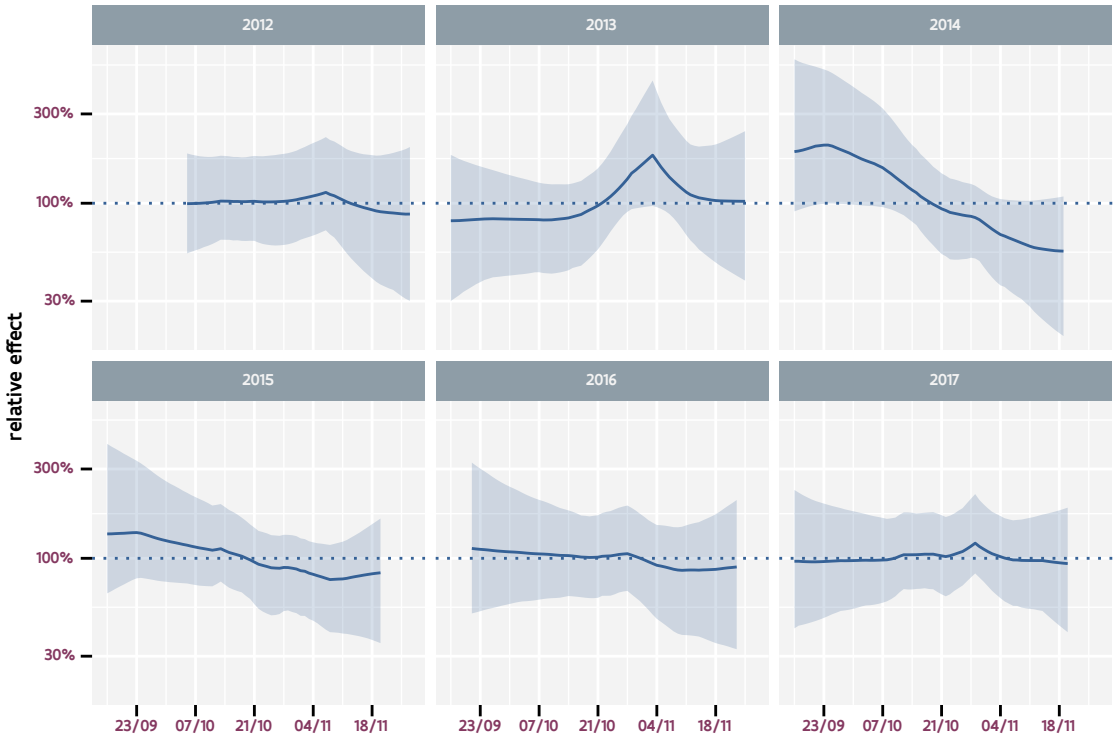

Figure 4.159: Seasonal pattern for *Chloris chloris*.

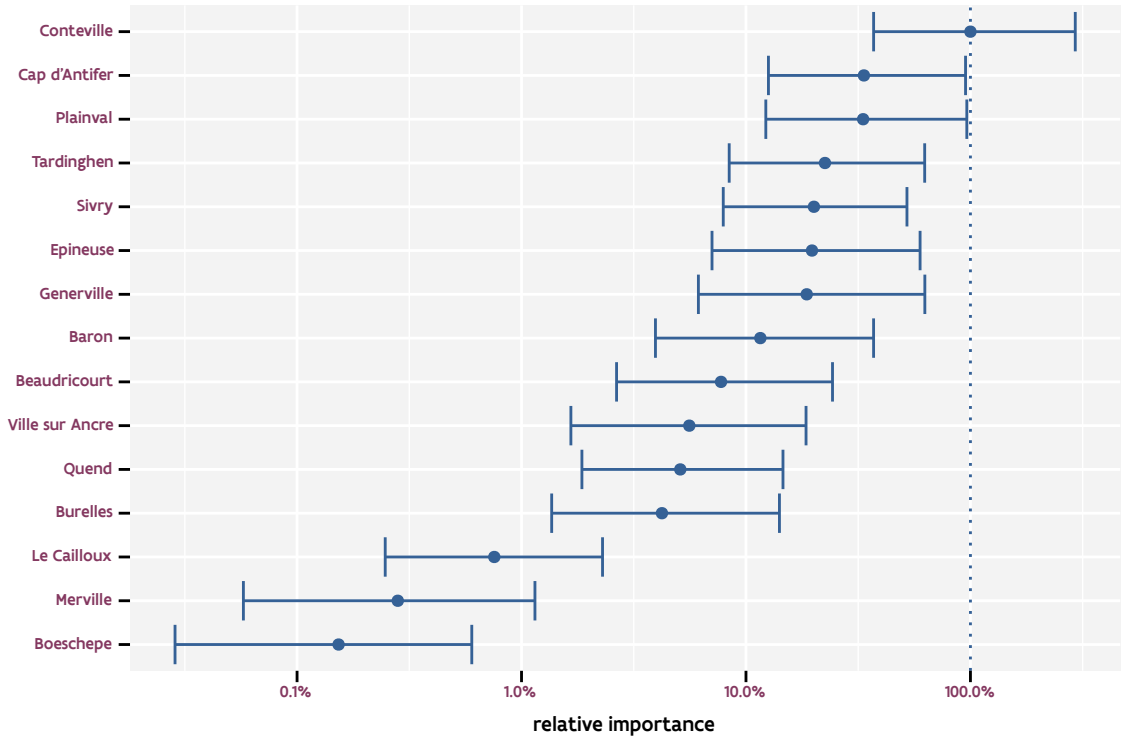

Figure 4.160: Relative importance per site for *Chloris chloris*.

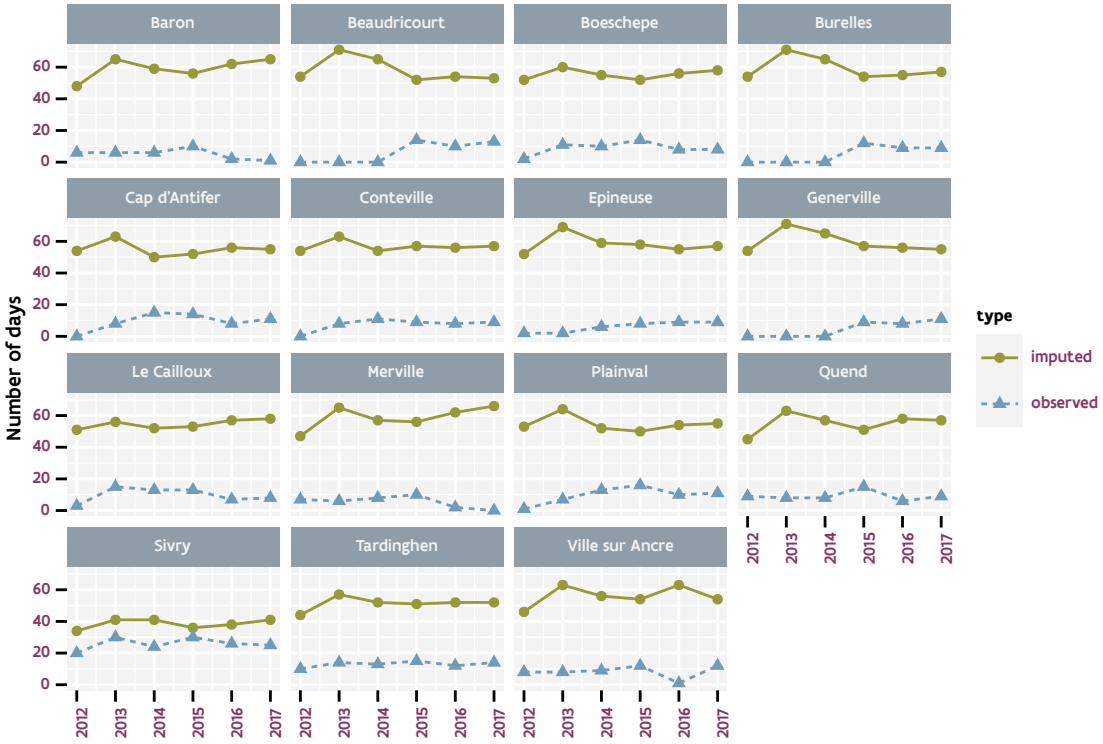

Figure 4.161: Number of days with observations per site and per year for *Chloris chloris*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

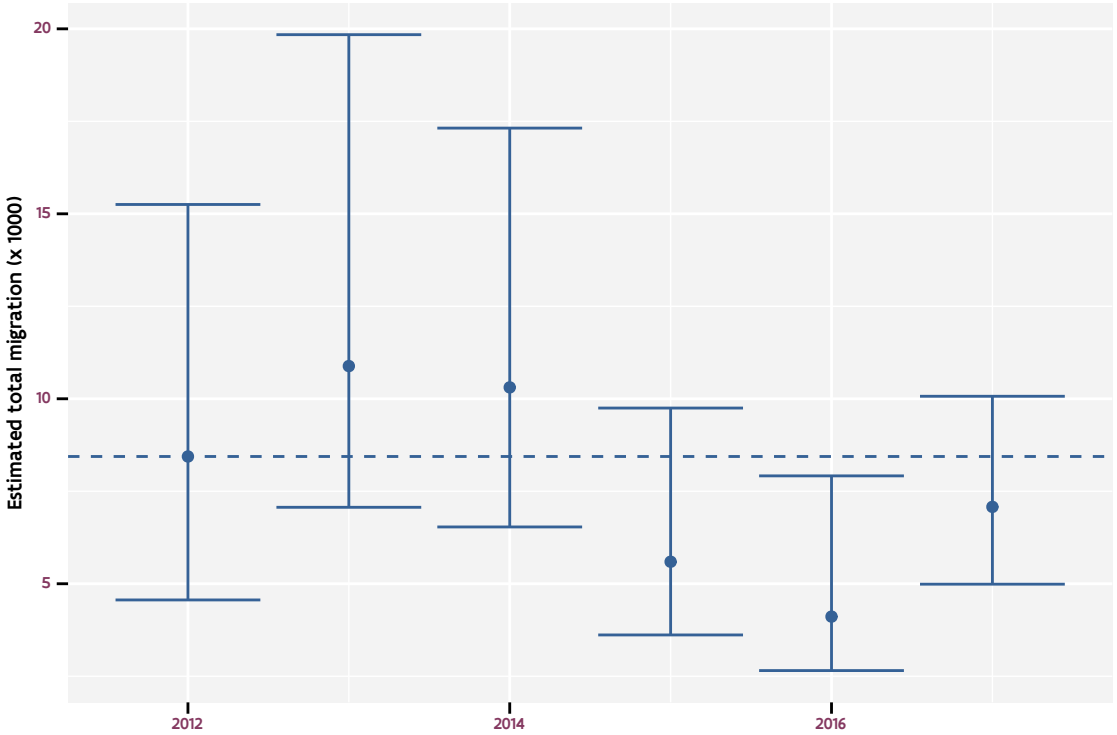

Figure 4.162: Imputed total of *Chloris chloris* during the migration period.

4.28 *CARDUELIS CARDUELIS*

- English: goldfinch
- French: chardonneret élégant
- Dutch: putter
- EURING: 16530

More information on *Carduelis carduelis*: https://www.gbif.org/species/2494686

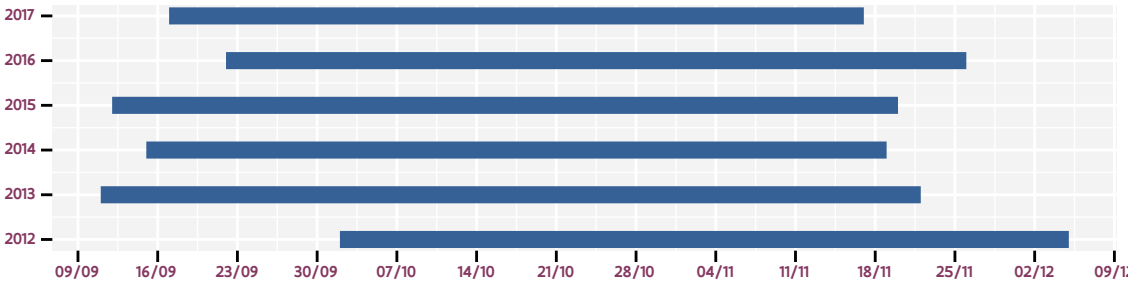

Figure 4.163: Migration periods used for *Carduelis carduelis*.

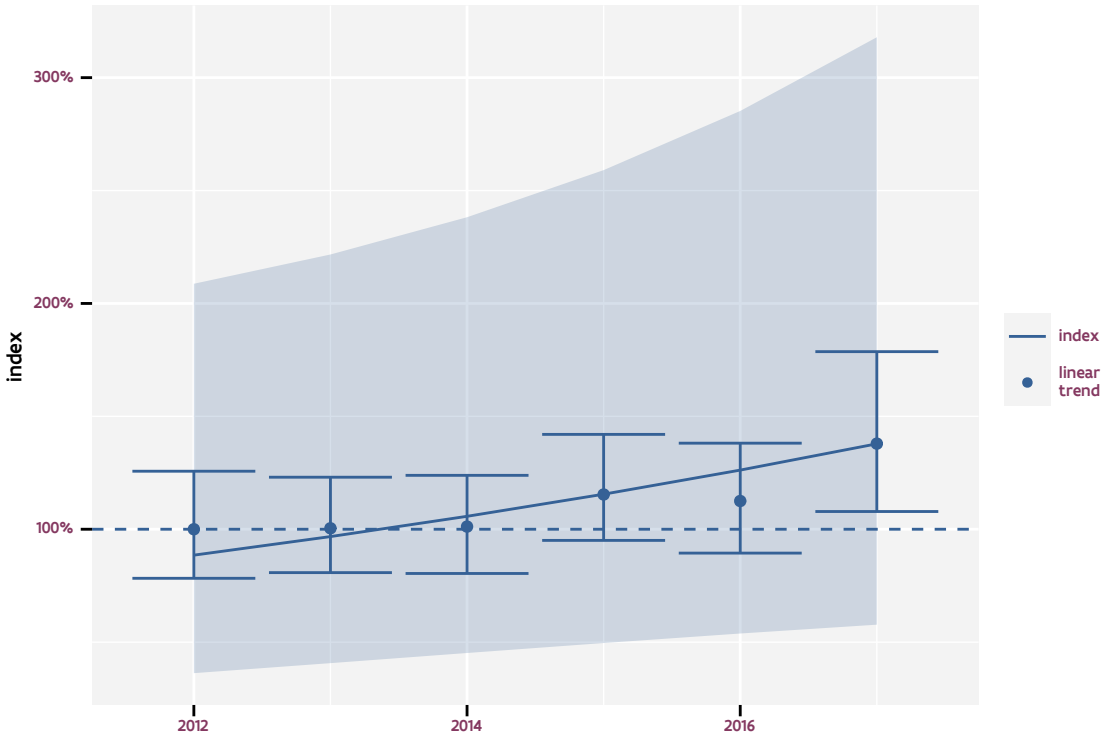

Figure 4.164: Indices and linear trend for *Carduelis carduelis*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

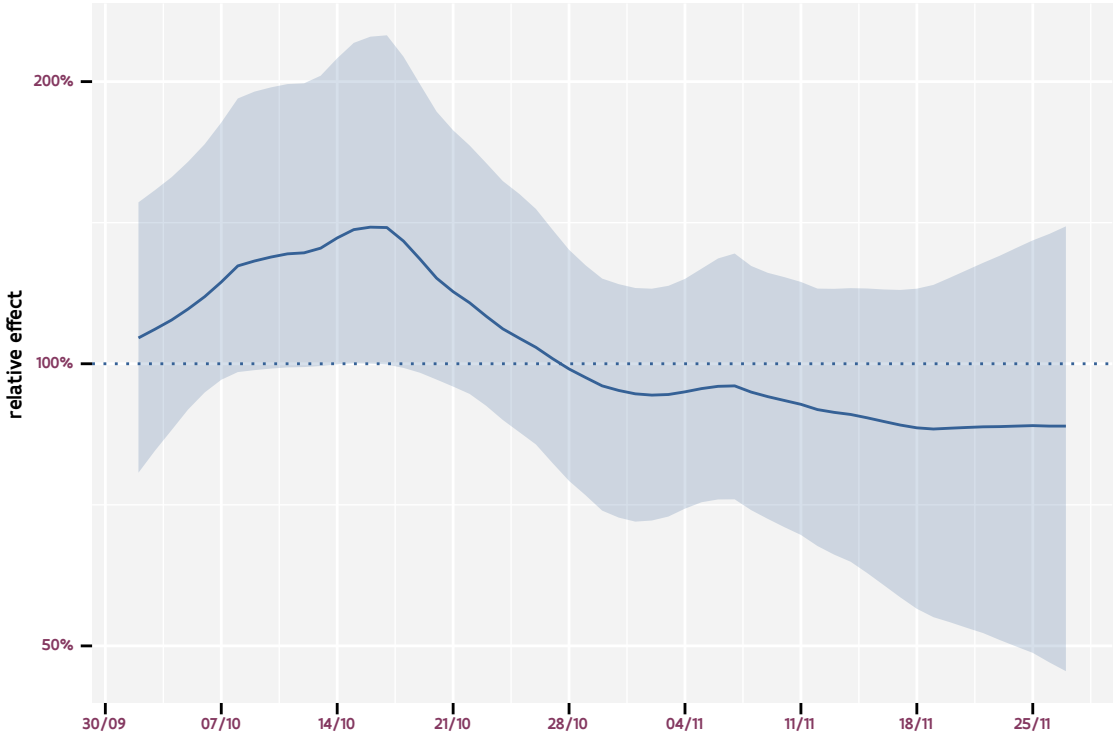

Figure 4.165: Seasonal pattern for *Carduelis carduelis*.

https://doi.org/10.21436/inbor.16917180

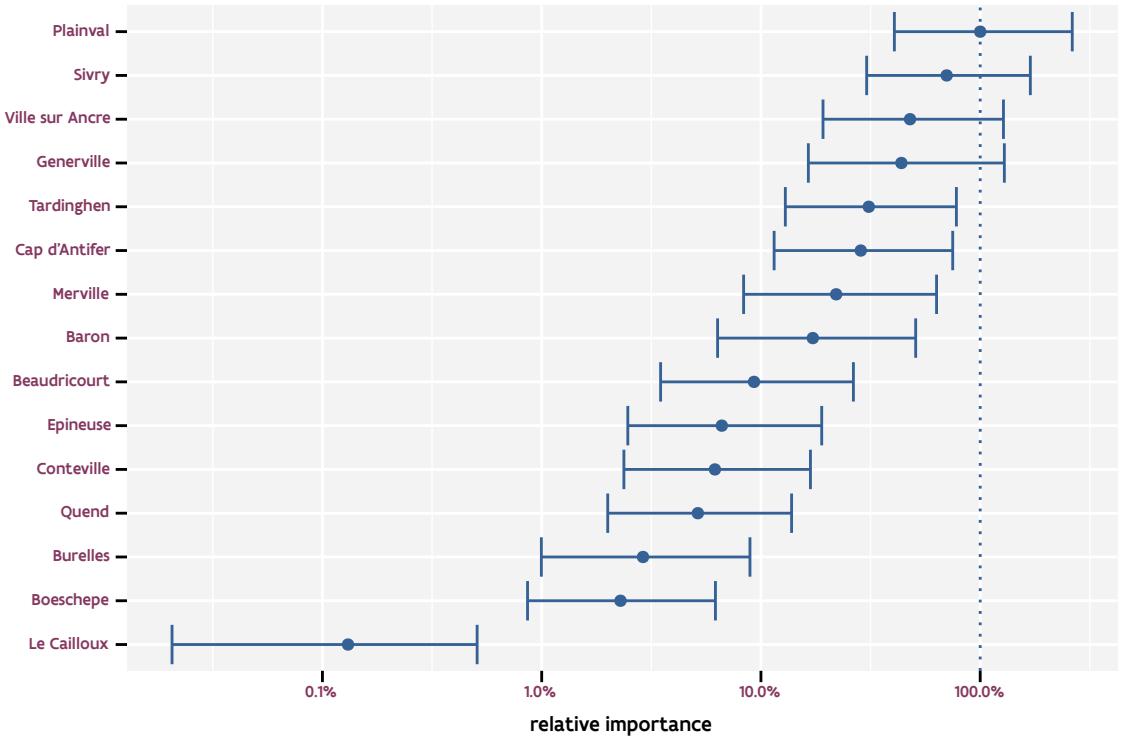

Figure 4.166: Relative importance per site for *Carduelis carduelis*.

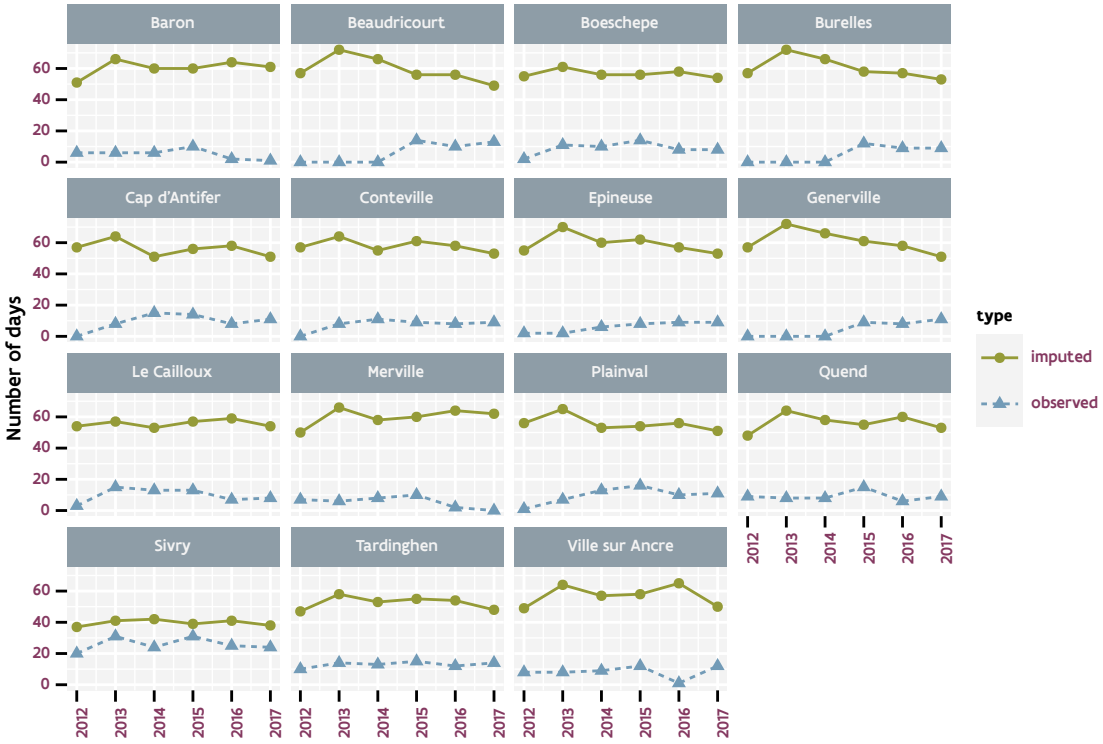

Figure 4.167: Number of days with observations per site and per year for *Carduelis carduelis*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

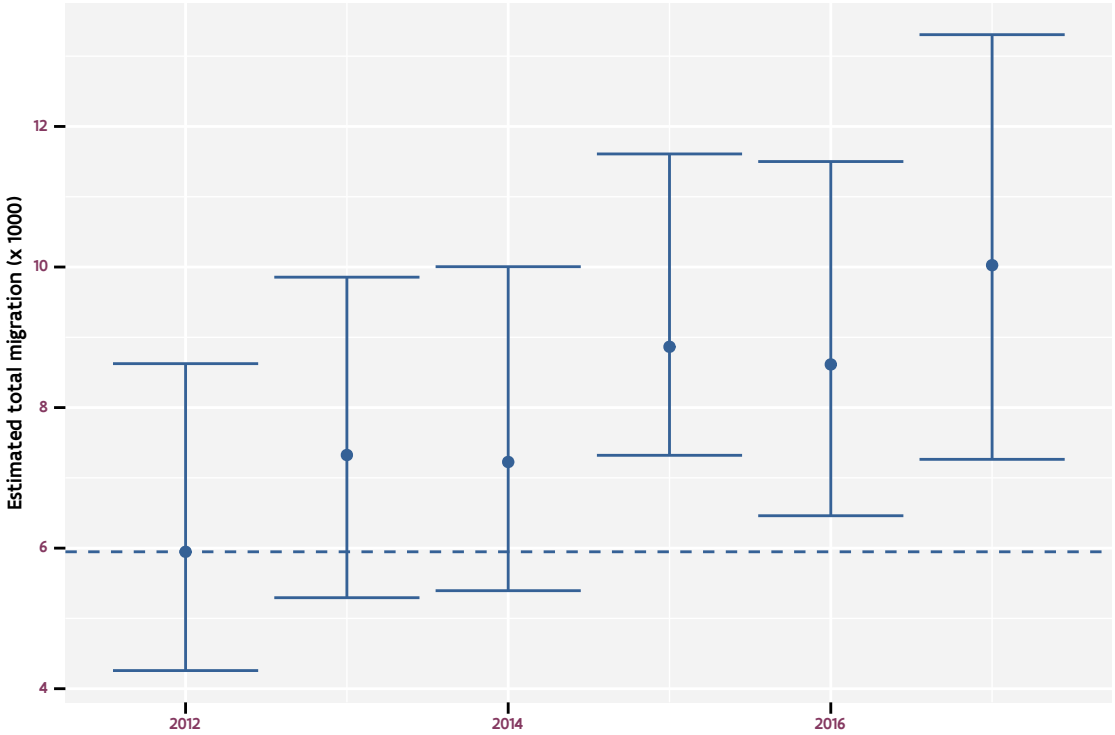

Figure 4.168: Imputed total of *Carduelis carduelis* during the migration period.

4.29 *SPINUS SPINUS*

- English: Eurasian siskin
- French: tarin des aulnes
- Dutch: Sijs
- EURING: 16540

More information on *Spinus spinus*: https://www.gbif.org/species/6092830

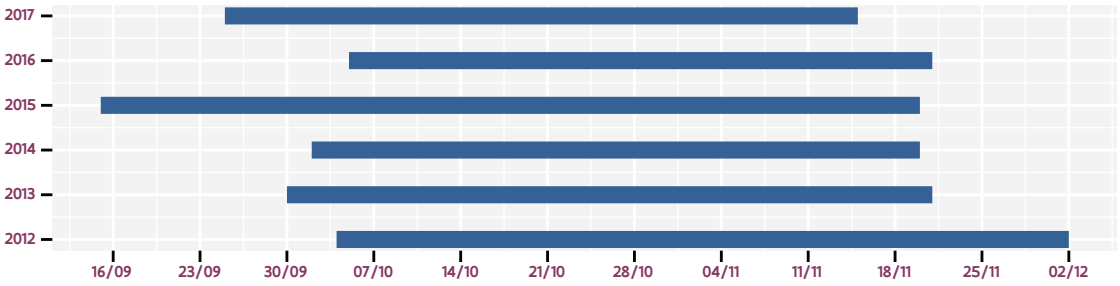

Figure 4.169: Migration periods used for *Spinus spinus*.

https://doi.org/10.21436/inbor.16917180

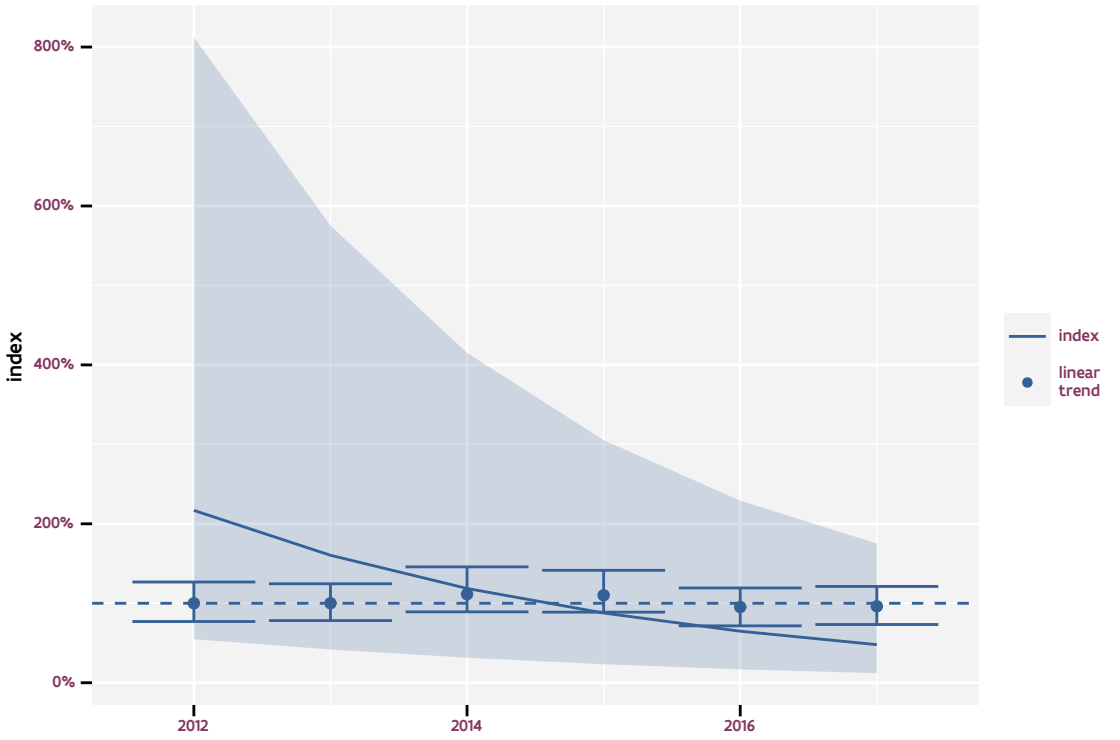

Figure 4.170: Indices and linear trend for *Spinus spinus*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

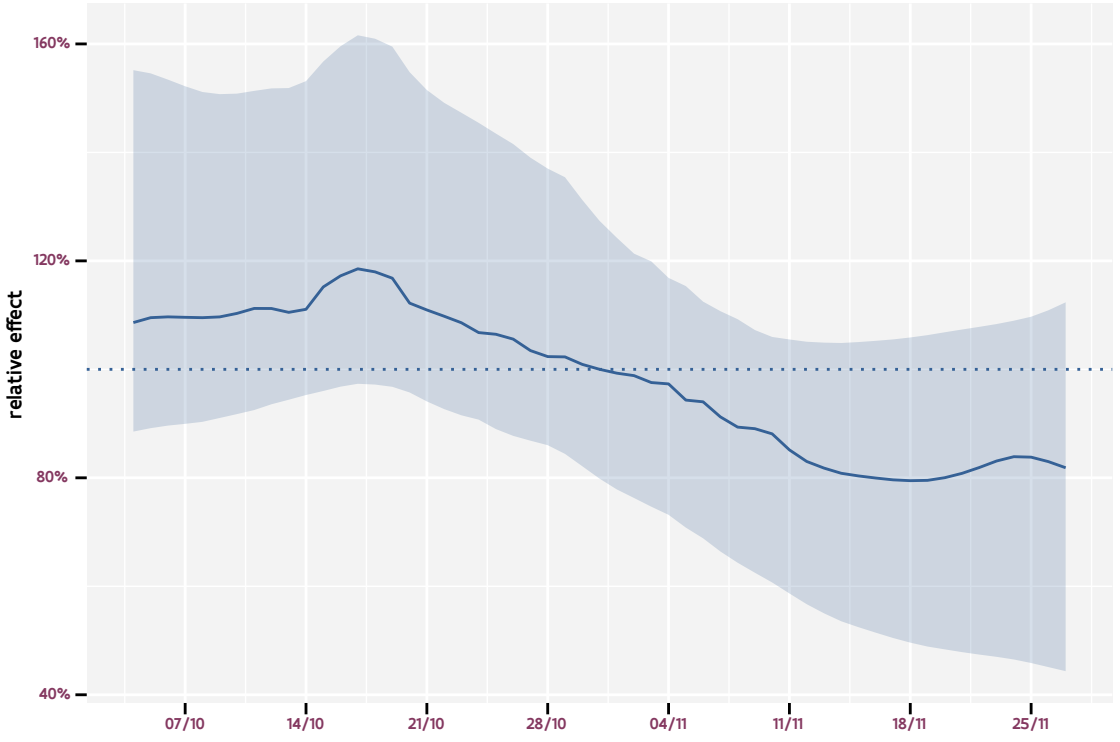

Figure 4.171: Seasonal pattern for *Spinus spinus*.

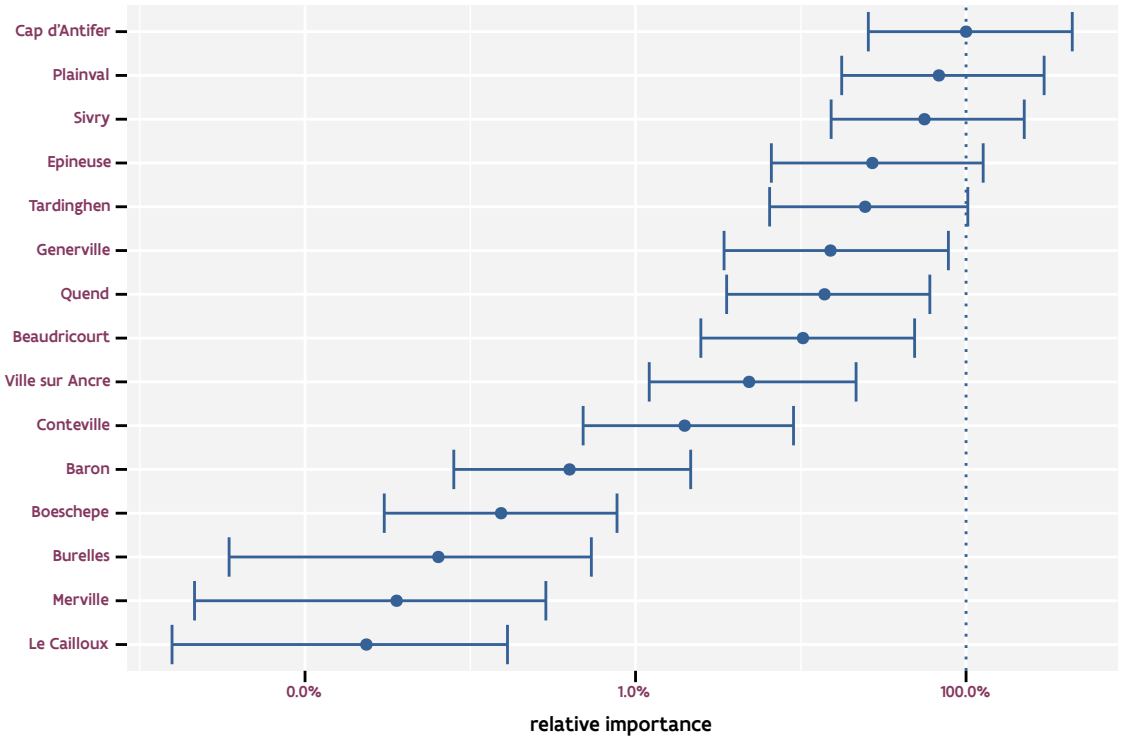

Figure 4.172: Relative importance per site for *Spinus spinus*.

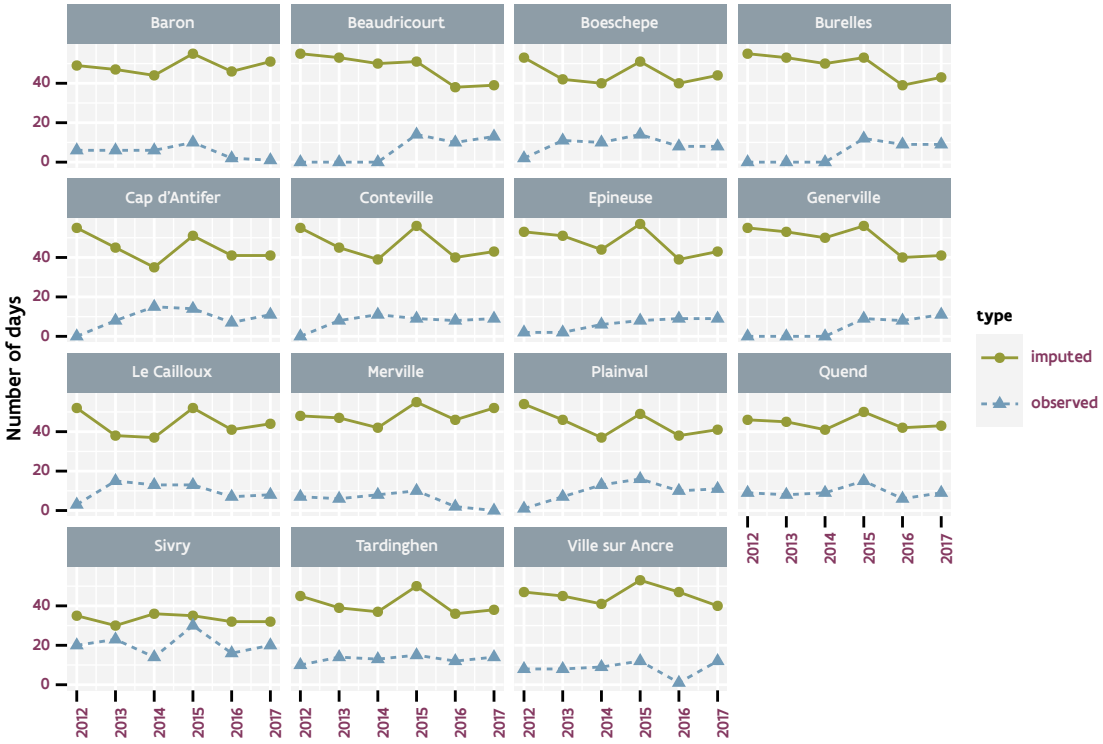

Figure 4.173: Number of days with observations per site and per year for *Spinus spinus*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

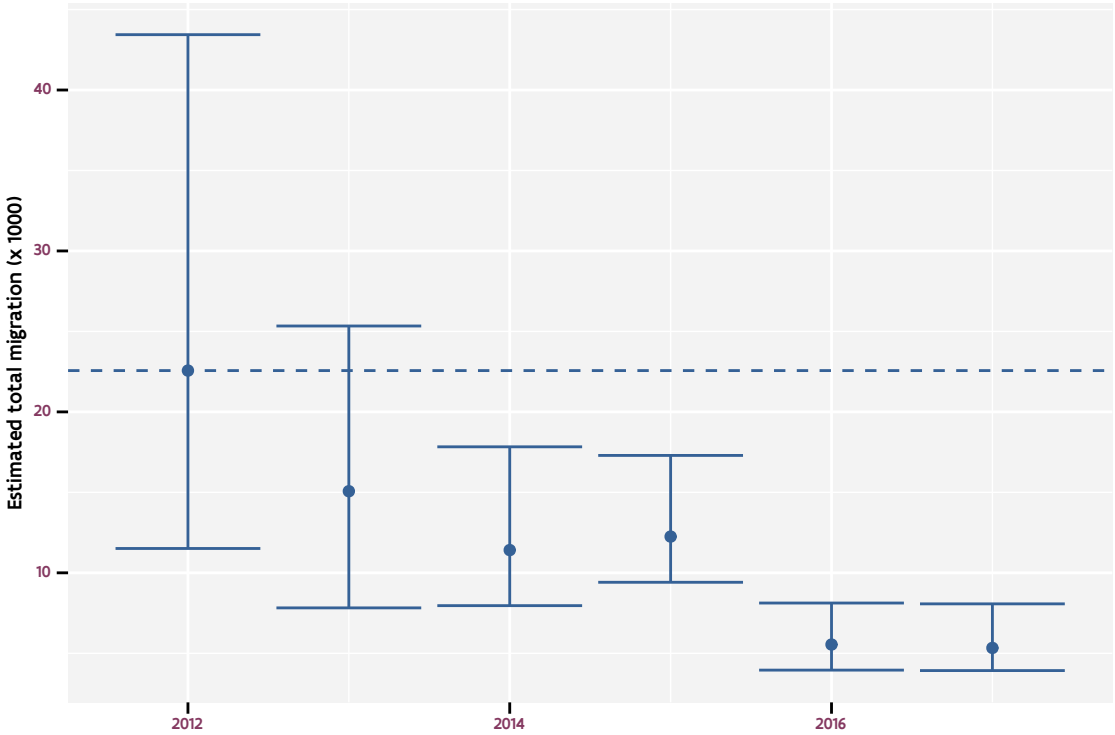

Figure 4.174: Imputed total of *Spinus spinus* during the migration period.

4.30 *LINARIA CANNABINA*

- English: common linnet
- French: linotte mélodieuse
- Dutch: Kneu
- EURING: 16600

More information on *Linaria cannabina*: https://www.gbif.org/species/8104397

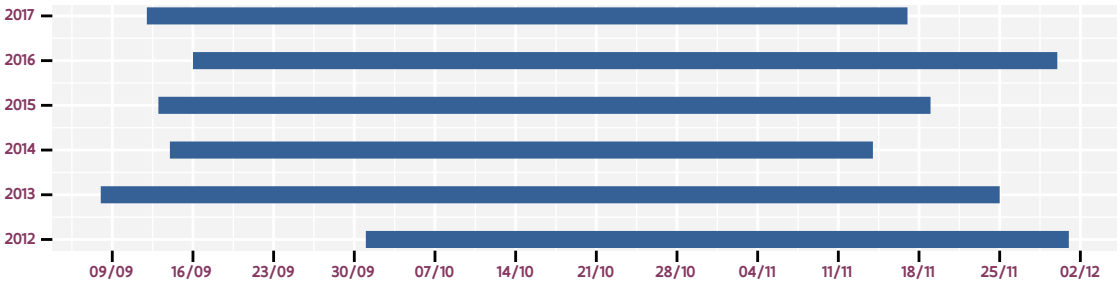

Figure 4.175: Migration periods used for *Linaria cannabina*.

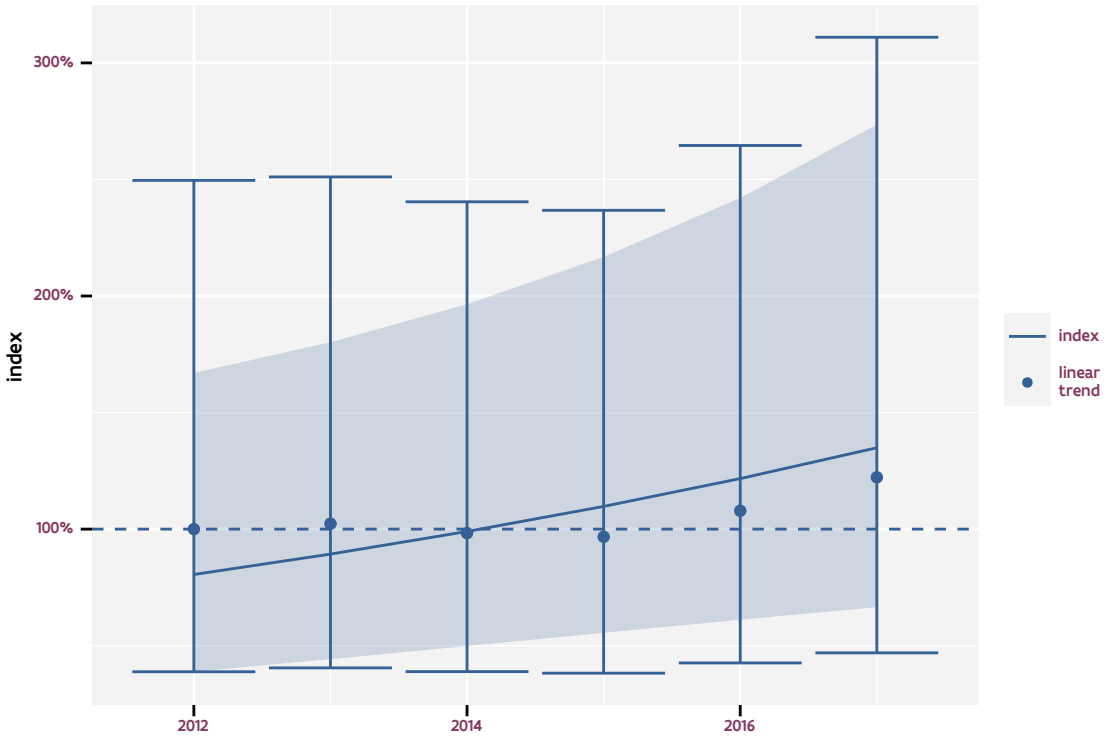

Figure 4.176: Indices and linear trend for *Linaria cannabina*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is non-linear.

Figure 4.177: Seasonal pattern for *Linaria cannabina*.

https://doi.org/10.21436/inbor.16917180

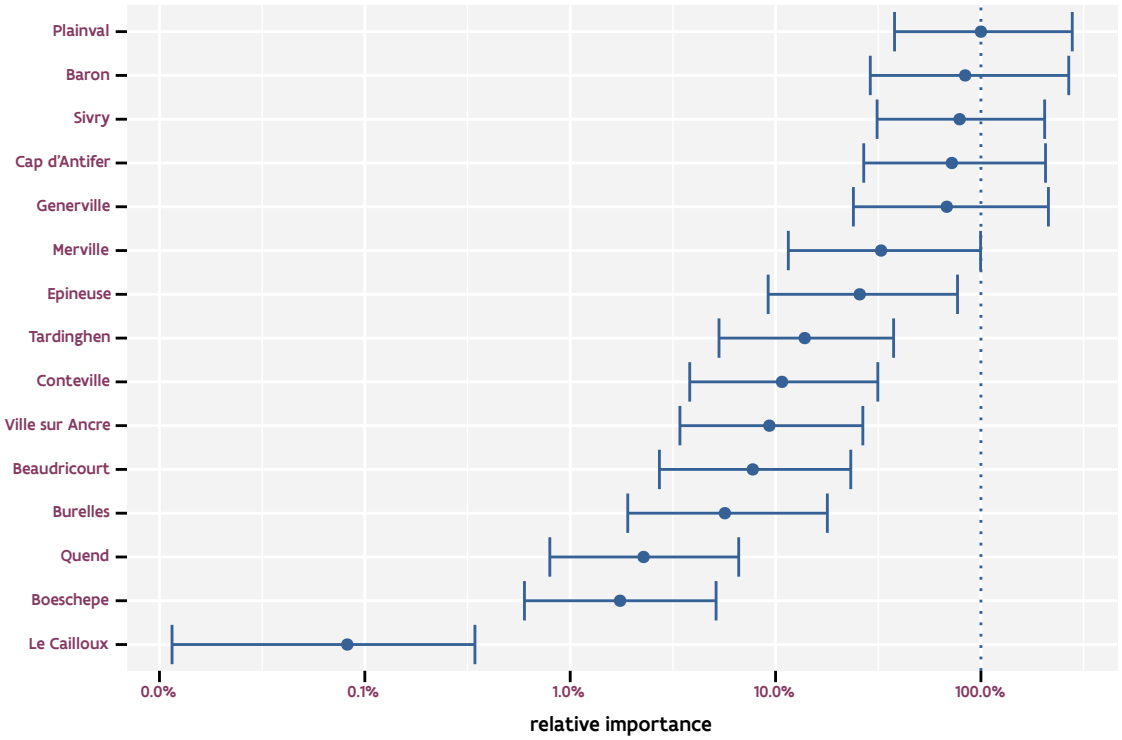

Figure 4.178: Relative importance per site for *Linaria cannabina*.

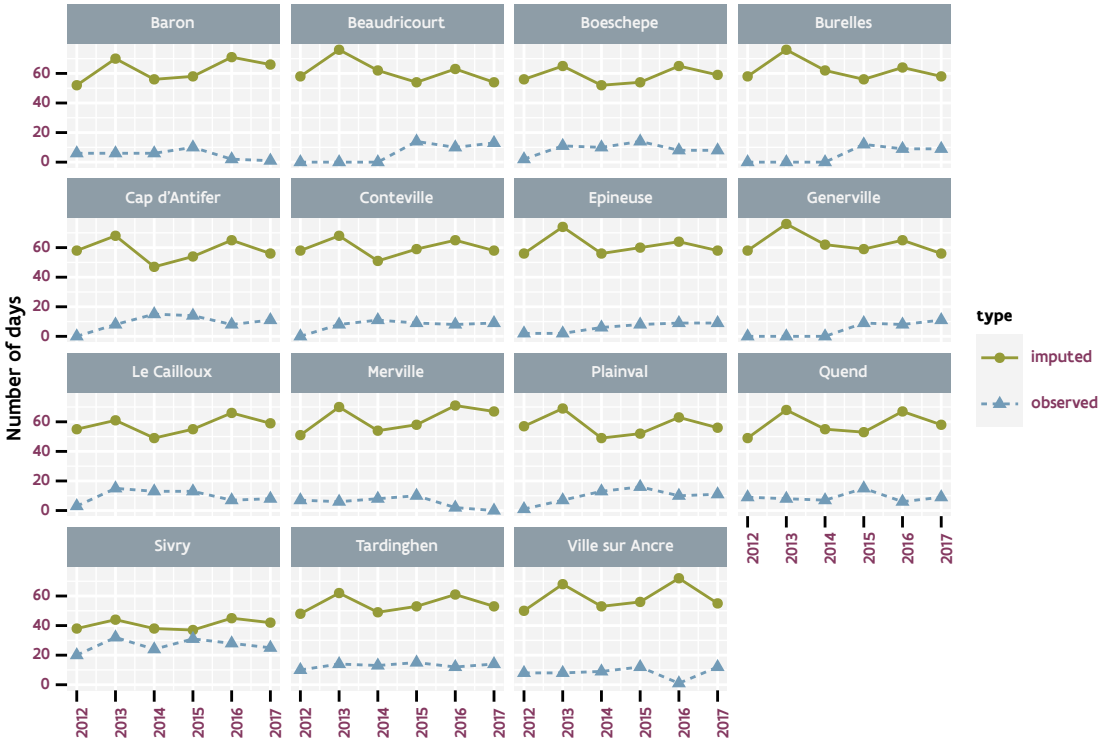

Figure 4.179: Number of days with observations per site and per year for *Linaria cannabina*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

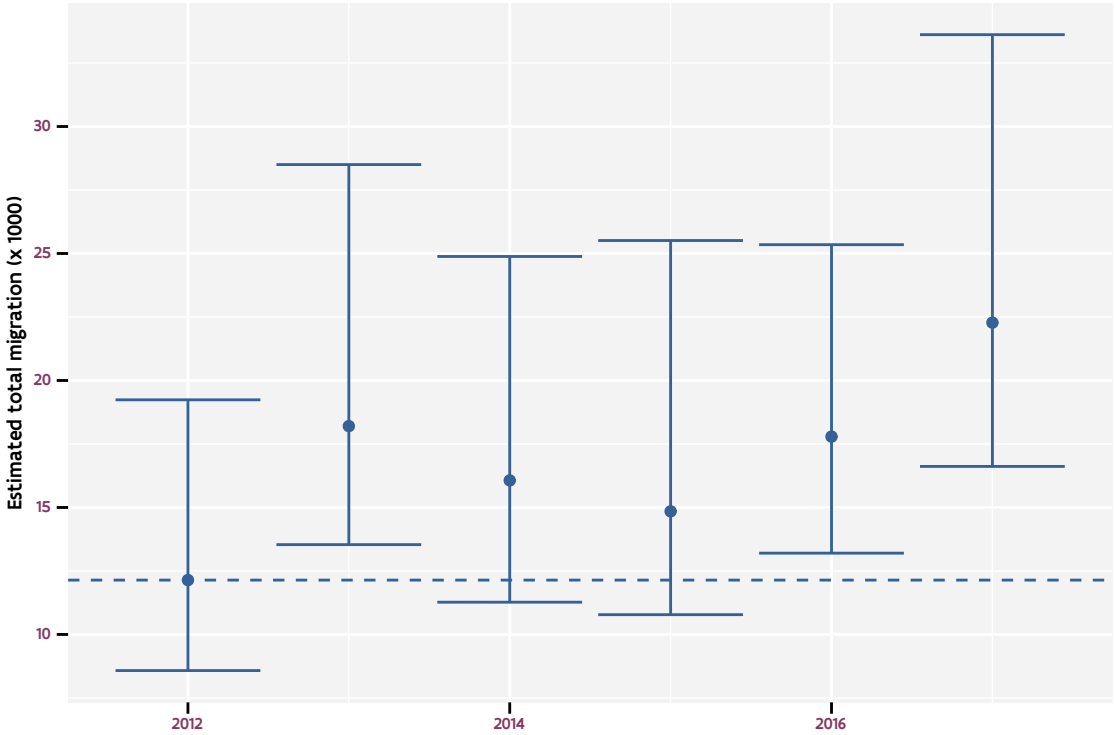

Figure 4.180: Imputed total of *Linaria cannabina* during the migration period.

4.31 *EMBERIZA CITRINELLA*

- English: yellowhammer
- French: bruant jaune
- Dutch: geelgors
- EURING: 18570

More information on *Emberiza citrinella*: https://www.gbif.org/species/2491534

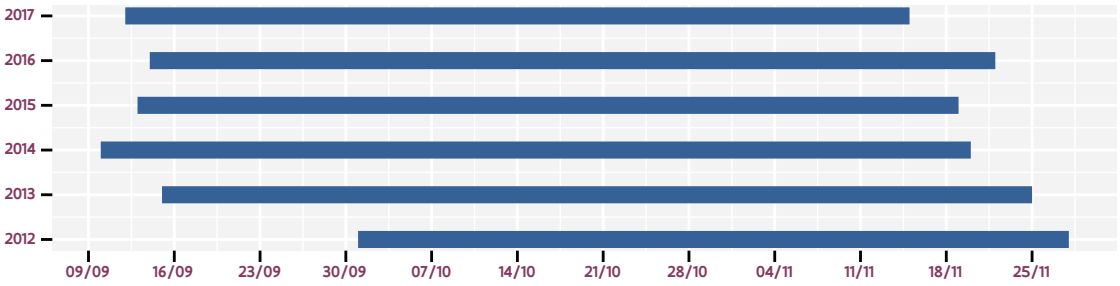

Figure 4.181: Migration periods used for *Emberiza citrinella*.

https://doi.org/10.21436/inbor.16917180

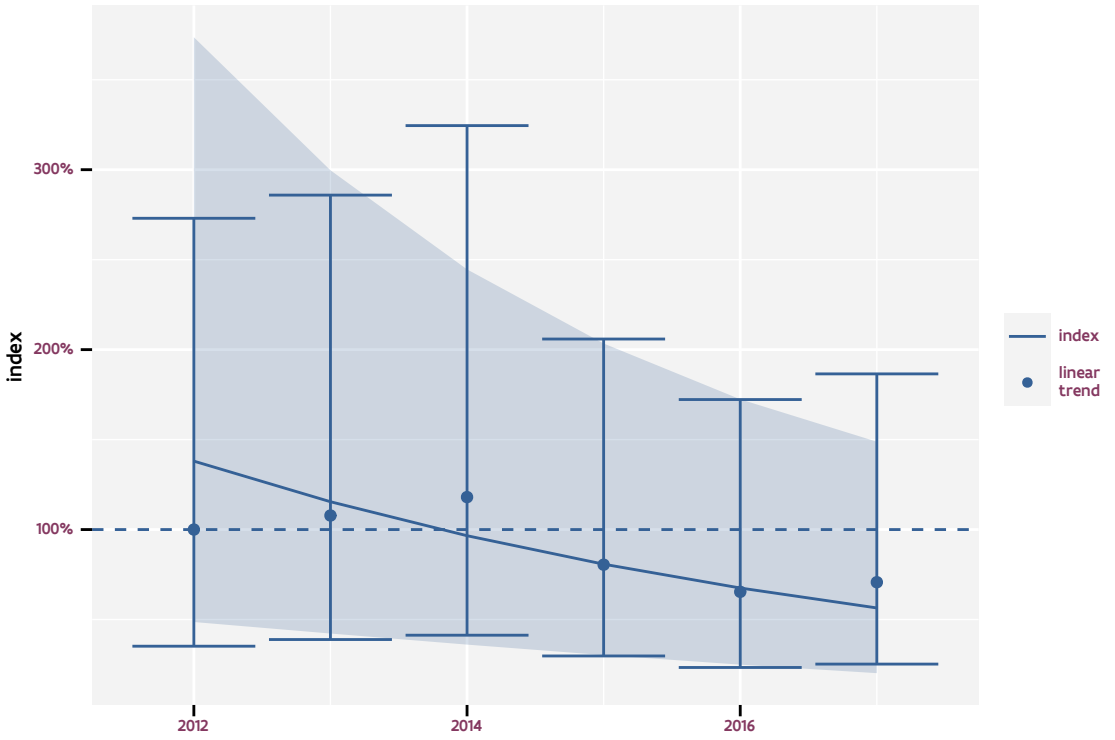

Figure 4.182: Indices and linear trend for *Emberiza citrinella*. The indices are indicated by points (estimates) and errorbars (95% credible interval). The linear trends is indicated by the line (estimated) and ribbon (95% credible interval). The trend pattern is linear.

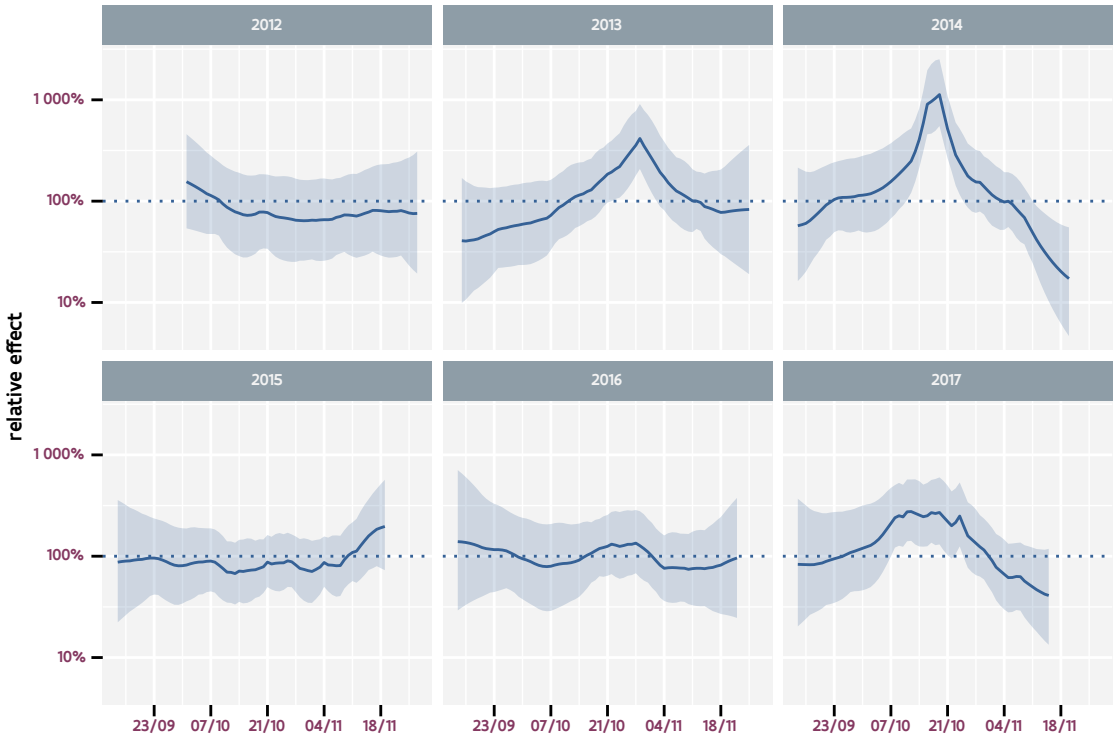

Figure 4.183: Seasonal pattern for *Emberiza citrinella*.

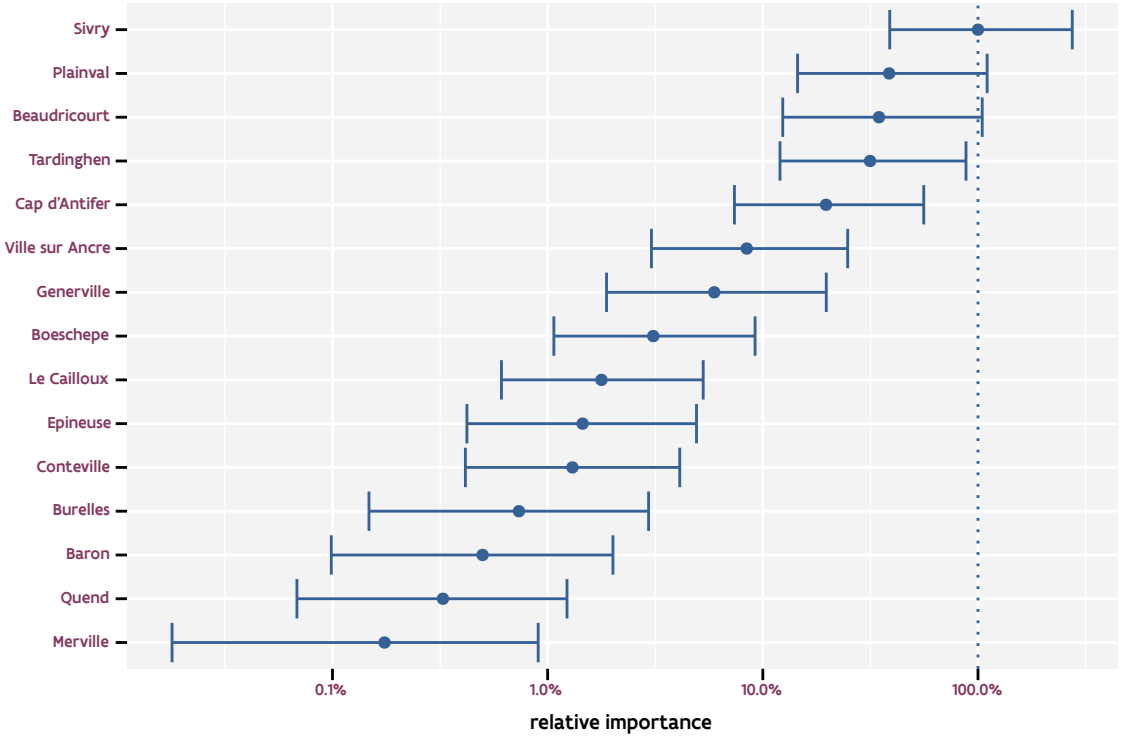

Figure 4.184: Relative importance per site for *Emberiza citrinella*.

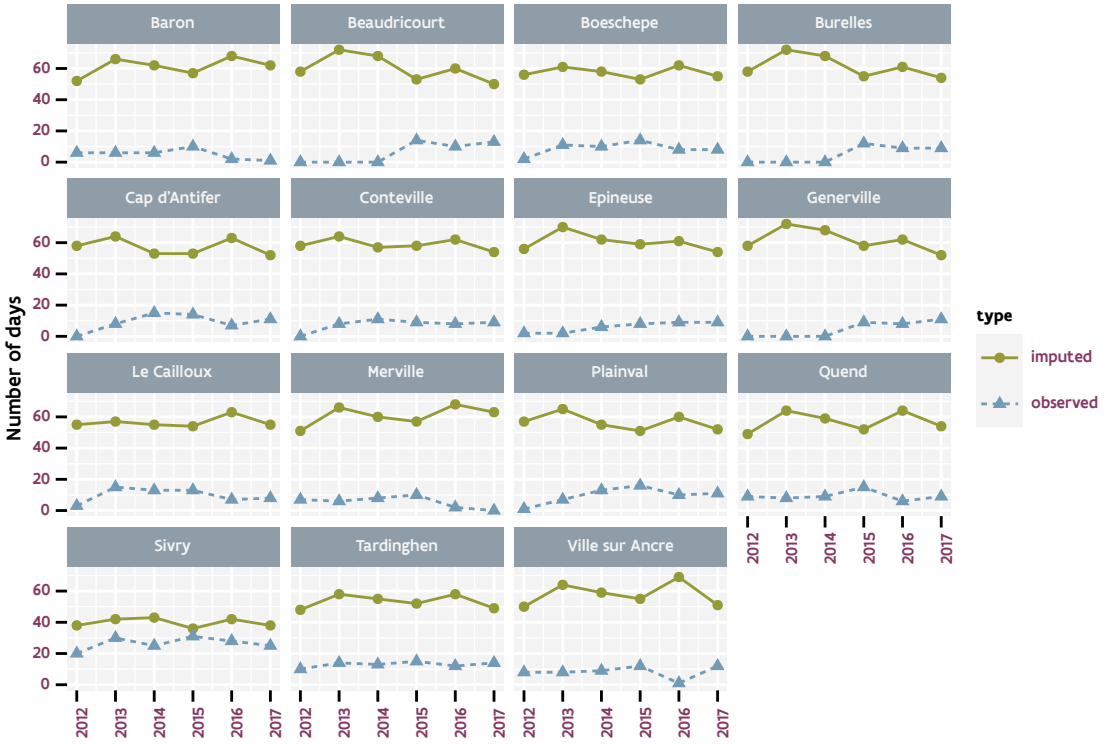

Figure 4.185: Number of days with observations per site and per year for *Emberiza citrinella*. 'observed' is the number of days at which the site was visited during the migration period of the species. 'imputed' is the number of days within the migration period in which the site was not visited.

https://doi.org/10.21436/inbor.16917180

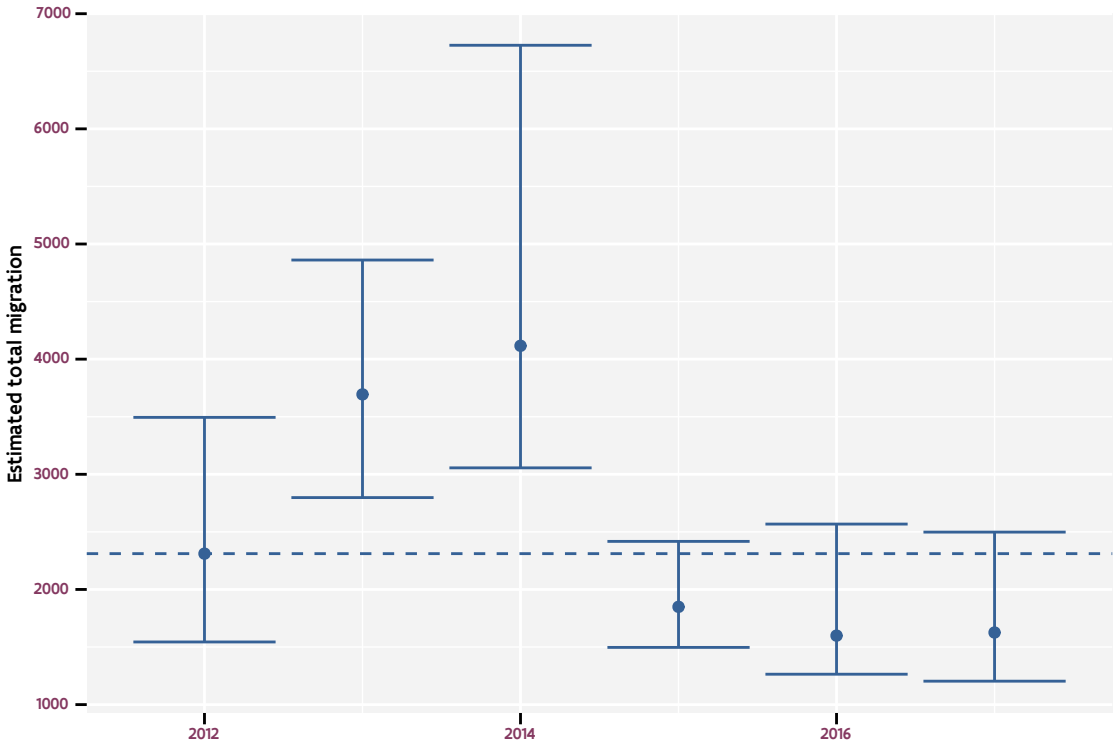

Figure 4.186: Imputed total of *Emberiza citrinella* during the migration period.

Bibliography

Onkelinx, T., Devos, K. & Quataert, P. (2018). multimput: Using Multiple Imputation to Address Missing Data. Https://doi.org/10.5281/zenodo.598331, https://github.com/inbo/multimput.

R Core Team (2019). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Rue, H., Lindgren, F., Simpson, D., Martino, S., Teixeira Krainski, E., Bakka, H., Riebler, A. & Fuglstad, G.A. (2019). INLA: Full Bayesian Analysis of Latent Gaussian Models using Integrated Nested Laplace Approximations. R package version 19.09.03.

Wickham, H. (2017). tidyverse: Easily Install and Load the 'Tidyverse'. URL https://CRAN.R-project.org/package=tidyverse. R package version 1.2.1.