

MONITORING OF MORTALITY IN BELGIAN HONEYBEE COLONIES 2019-2020

Aline Vilain, Sciensano
FASFC GT Varroa, 11/12/2020

Object

- Continuation of the program of surveillance of honeybee colonies health launched by FASFC in 2016.
- Description and monitoring of honeybee colonies mortality and its spatio-temporal variation.

Sampling methodology

- Population frame:
 - ~7200 registered beekeepers in Belgium: ~4600 in Flanders
 - ~2500 in Wallonia
 - ~140 in Brussels
- Sampling :
 - 2 stage random sampling :
 - 25 apiaries per LCU + 5 in Brussels
 - 1 to 6 colonies per apiary (only strong colonies)
 - Hainaut : 19 bekeepers had to be discarded because of delay in the fall visits.

=> 775 colonies selected in 179 apiaries.

Sample description

Geographical Entity	Number of beekeepers in population* (N)		Number of apiaries selected (n)		Number of total colonies within selected apiaries (Mi)	Number of selected colonies (mi)
	n	%	n	%	n	n
Belgium	6835	100	179	100	1514	775
Flanders	4500	66%	99	55%	952	426
Wallonia	2203	32%	75	42%	524	331
Brussels	132	2%	5	3%	38	18
Antwerp	1200	18%	25	14%	344	106
East-Flanders	979	14%	25	14%	165	106
Limburg	905	13%	18	10%	199	91
Flemish Brabant	801	12%	7	4%	55	31
West Flanders	615	9%	24	13%	189	92
Hainaut	585	9%	6	3%	33	28
Liege	484	7%	15	8%	221	94
Luxembourg	446	7%	17	9%	90	78
Namur	419	6%	24	13%	96	68
Walloon Brabant	269	4%	13	7%	84	63

*After cleaning of database

Data collection

- 3 visits :
 - Fall 2019
 - Spring 2020 : by phone
 - Summer 2020 : 29 of the 165 beekeepers interviewed by phone.
- Data:
 - Number of colonies alive, dead, sold, potential reason of death, feeding strategy, treatment.
 - Merged colonies considered as dead.

Methodology : Statistical analysis

- Winter mortality
 - Colony mortality (Pi_{v2}):

$$Pi_{v2} = \frac{dead_{v2}}{mi_{v1}}$$

- Weighed Colony Sample Mortality (WCSM) :

$$WCSM = \frac{\sum(Mi_{v1} * Pi_{v2})}{\sum Mi_{v1}}$$

- Seasonal mortality

- $Pi_{v3} = \frac{dead_{v3}}{mi_{v2}}$

- Year mortality

- $Pi_{vy} = \frac{dead_{v2} + dead_{v3}}{mi_{v1}}$

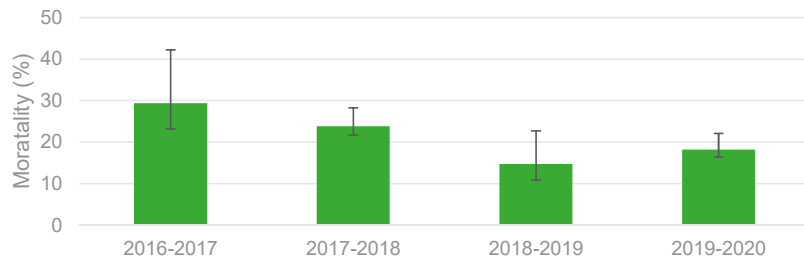
Results: Winter Mortality

Overwintering weighted colony mortality from Fall to Spring											
Geographical entity	Number of sampled apiaries	Number of sampled colonies	Estimated mortality								
			2016-2017		2017-2018		2018-2019		2019-2020		
			%	95% CI	%	95% CI	%	95% CI	%	95% CI	
Belgium	179	775	29.34	23.19-36.03	23.81	21.66-26.10	14.73	10.81-18.74	18.2	16.34	20.2
Brussels	5	426	40	NA	61.76	38.53-80.66	20	4.59-52.06	22.81	12.13	38.5
Flanders	99	331	32.02	18.09-35.84	27.47	24.35-30.83	15.34	13.08-17.92	21.76	19.24	24.5
Antwerp	25	18	28.61	9.49-40.14	15.91	11.21-22.07	13.25	9.19-18.7	29.36#	24.79	34.4
East-Flanders	25	106	53.09	23.96-66.27	13.66	8.91-20.29	25.09	17.26-34.94	14.04	9.49	20.2
Limburg	18	106	18.11	0.68-31.32	8.21	3.28-17.79	8.52	5.82-12.26	7.55	4.55	12.2
Flemish Brabant	7	91	27.43	11.52-31.97	57.45	50.8-63.84	20.36	14.65-27.54	46.36*	33.85	59.4
West Flanders	24	31	28.77	12.62-35.35	17.57	11.79-25.32	22.61	15.87-31.12	22.44**	17.05	28.9
Wallonie	75	92	26.73	16.12-28.26	18.88	16.09-22.03	13.93	11.59-16.65	11.41	8.95	14.4
Hainaut	6	28	20.69	7.43-28.63	24.13	17.64-32.06	23.74	18.43-30	36.06***	21.88	53.1
Liege	24	94	18.88	3.04-25.56	7.05	4.05-11.84	10.74	7.34-15.41	6.94	4.19	11.2
Luxembourg	17	78	33.98	11.23-42.89	27.33	20.67-35.18	11.19	6.36-18.75	4.81	1.62	11.7
Namur	15	68	27.46	9.92-39.21	22.04	15.6-30.16	12.5	7.47-20.01	8.75	4.36	16.3
Walloon Brabant	13	63	33.9	14.39-41.75	17.05	10.5-26.35	1.49	0-8.75	23.61	15.74	33.79

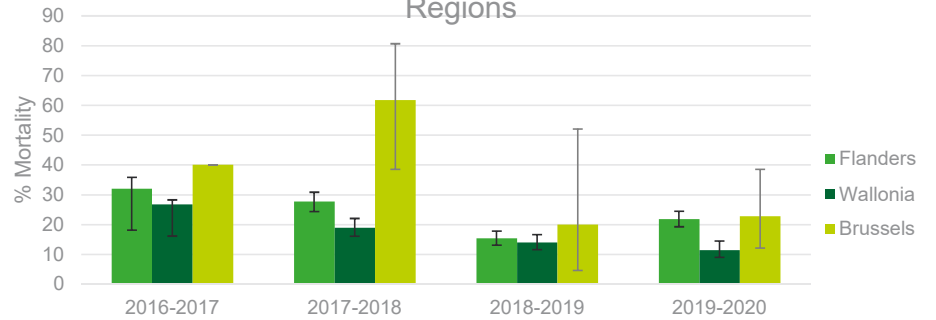
• Without extreme value: 32.9 (20.87-47.78), **: 17.65 (12.71-23.96), ***:18.33(7.14-38.26);
without big apiary:13.40 (9.21-18.96)

Winter Mortality

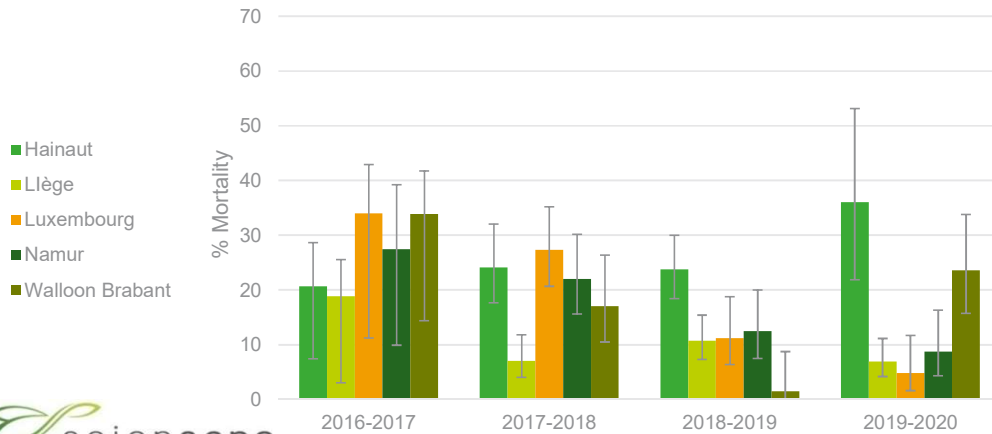
Belgium



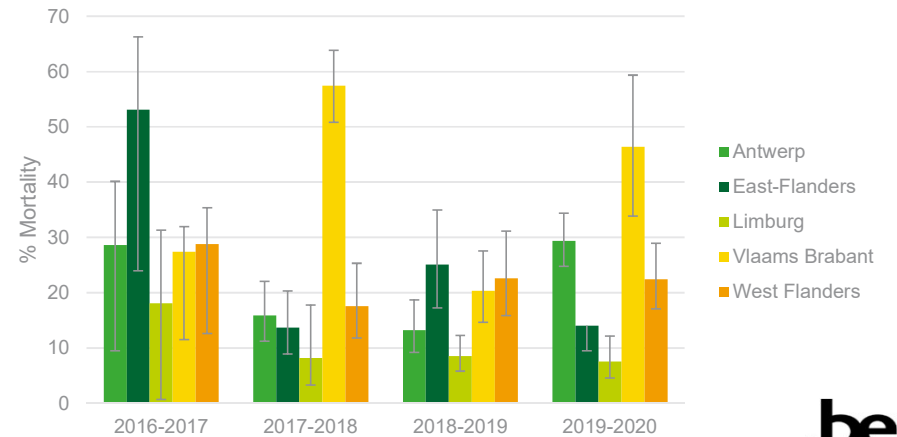
Regions



Walloon provinces

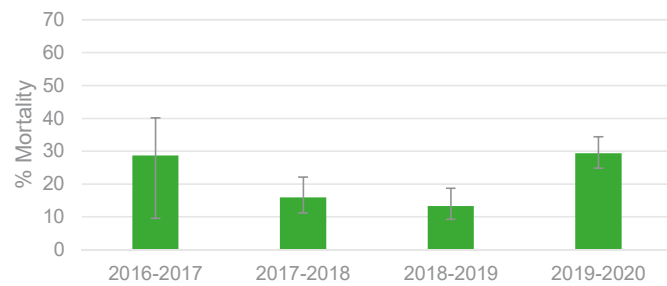


Winter Flamish provinces

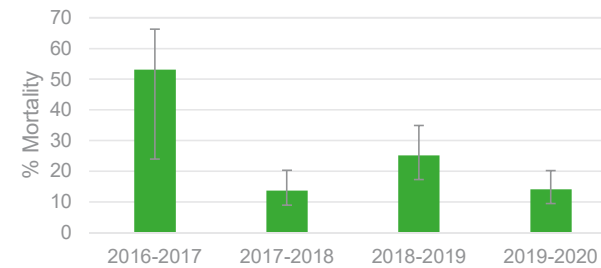


Winter Mortality: Flemish provinces

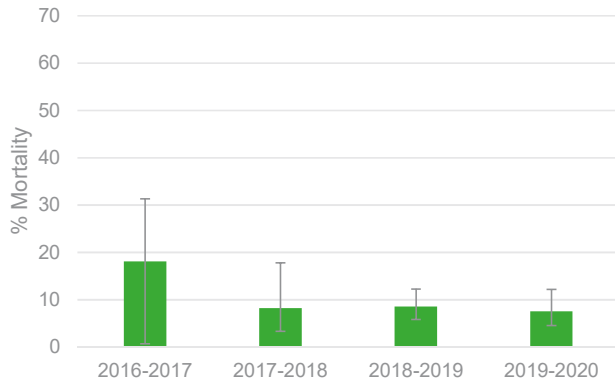
Antwerp



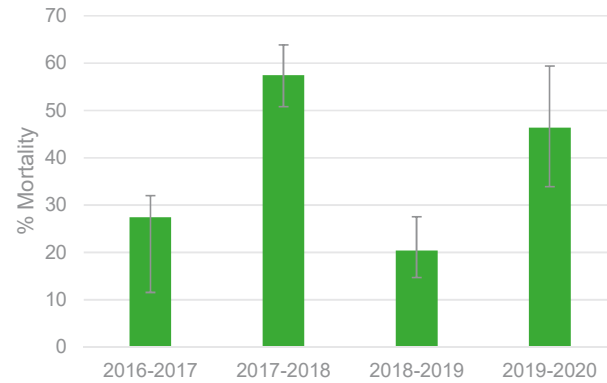
East-Flanders



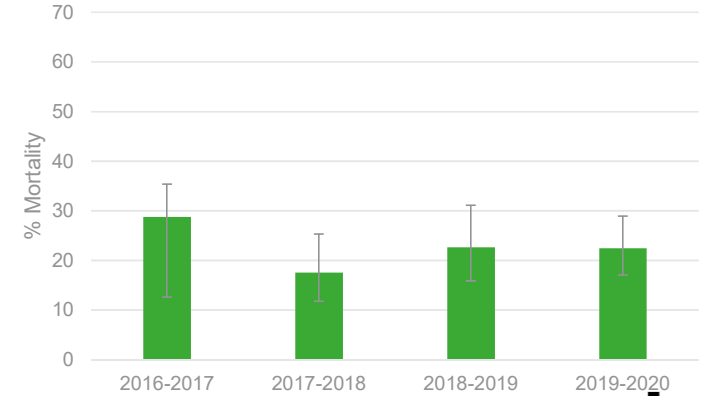
Limbourg



Flemish-Brabant

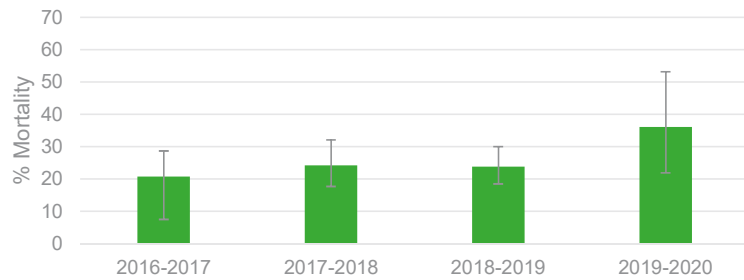


West-Flanders

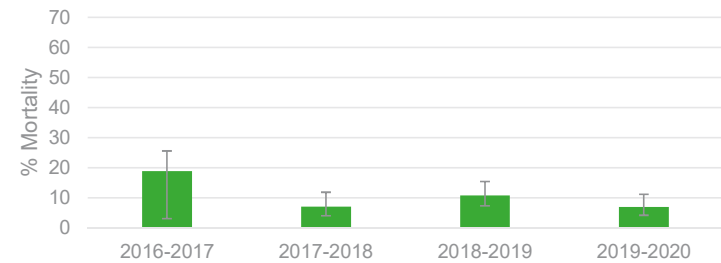


Winter Mortality : Walloon provinces

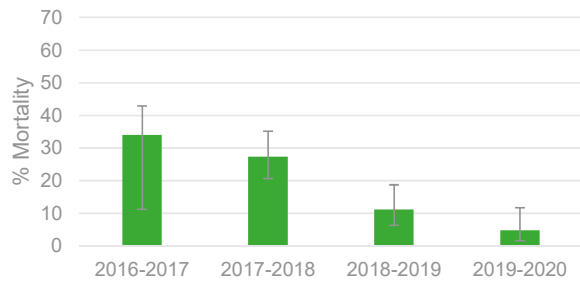
Hainaut



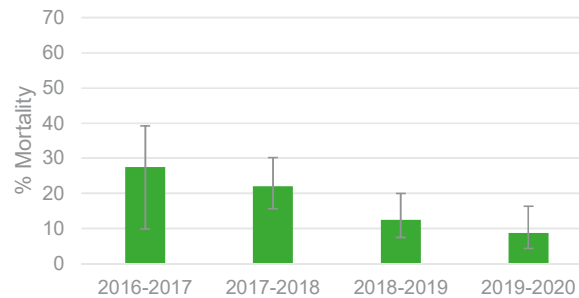
Liege



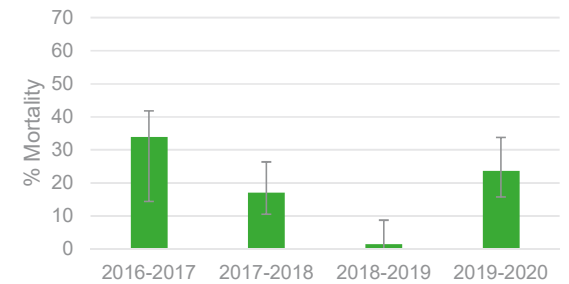
Luxembourg



Namur



Walloon Brabant

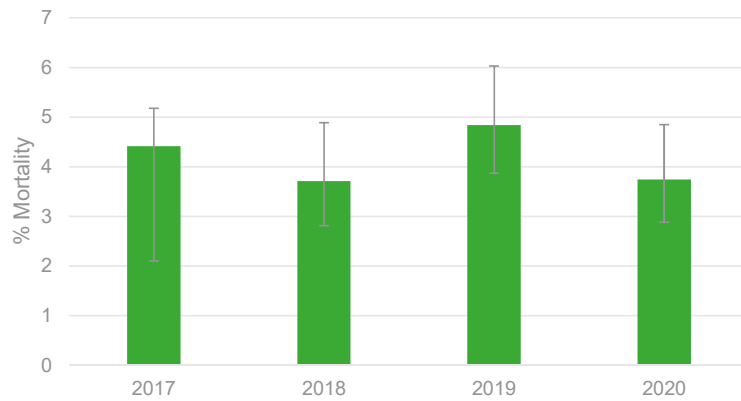


Results : Seasonal Mortality

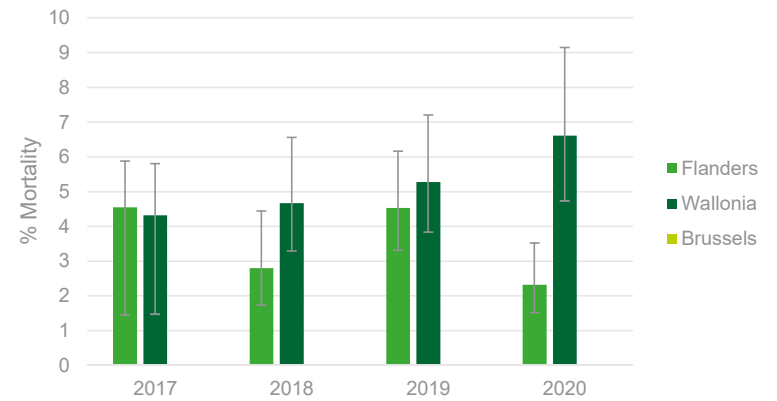
Seasonal weighted colony mortality from Spring to Summer											
Geographical entity	Number of sampled apiaries	Number of sampled colonies	Estimated mortality								
			2017		2018		2019		2020		
			%	95% CI	%	95% CI	%	95% CI	%	95% CI	
Belgium	165	637	4.41	2.10 - 5.18	3.71	2.81 - 4.89	4.84	3.87 - 6.03	3.74	2.88	4.85
Brussels	4	13	0	NA	0	NA	0	NA	0	NA	NA
Flanders	91	343	4.54	1.45 - 5.88	2.79	1.73 - 4.44	4.53	3.31 - 6.16	2.32	1.51	3.52
Antwerp	23	84	2.71	0 - 5.95	0	NA	0	NA	2.93	1.53	5.38
East-Flanders	23	87	2.59	0 - 6.43	3.47	1.28 - 8.09	18.92	11.91 - 28.62	3.48	1.39	7.71
Limburg	18	81	7.03	0 - 12.60	1.54	0 - 9.00	2.5	1.16 - 5.05	1.00	0.04	3.83
Flemish Brabant	6	18	7.24	0.53-12.05	0.85	0 - 5.16	5.91	2.98 - 11.05	0	NA	NA
West Flanders	21	73	3.88	0 - 5.44	8.4	4.52 - 14.80	5.31	2.22 - 11.34	2.09	0.57	5.67
Wallonie	70	281	4.31	1.47 - 5.80	4.66	3.29 - 6.56	5.27	3.83 - 7.20	6.61	4.73	9.15
Hainaut	5	14	9.69	1.97 - 15.06	4.73	2.03 - 9.95	6.1	3.33 - 10.69	3.57	0	19.2
Liege	23	88	1.49	0 - 2.99	6.12	3.35 - 10.72	6.13	3.63 - 10.04	3.57	1.69	7.04
Luxembourg	16	70	6.54	0.38-10.39	0.7	0 - 4.25	6.51	2.95 - 13.11	11.43	6.11	20.1
Namur	15	63	0.83	0 - 2.20	4.65	1.89 - 10.13	2.5	0.47 - 7.68	6.25	2.63	13.2
Walloon Brabant	11	46	3.05	0 - 7.17	8.14	3.72 - 16.17	2.74	0.08 - 10.52	11.6	5.94	21

Seasonal Mortality

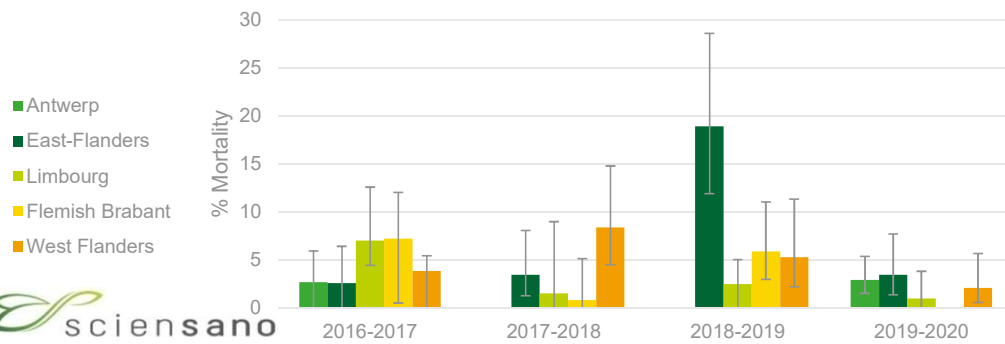
Belgium



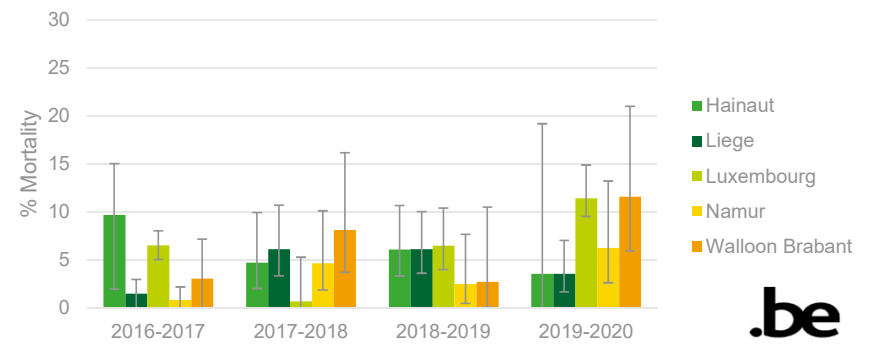
Regions



Flemish provinces



Walloon provinces

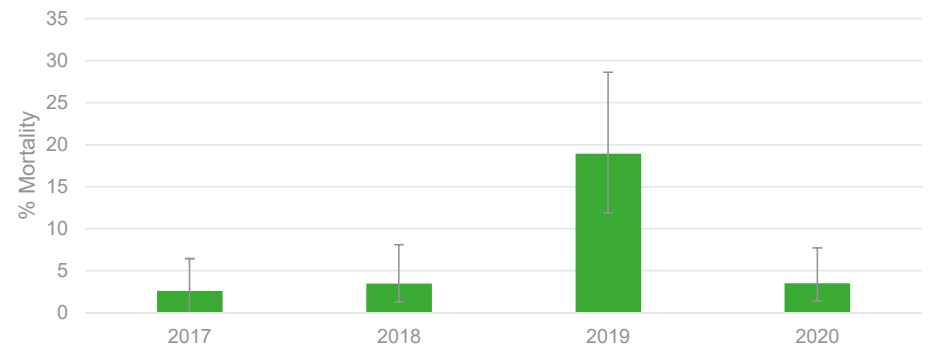


Seasonal Mortality: Flemish Provinces

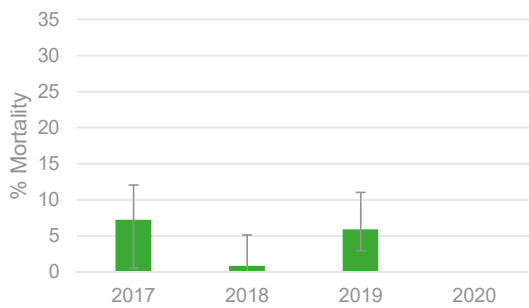
Antwerp



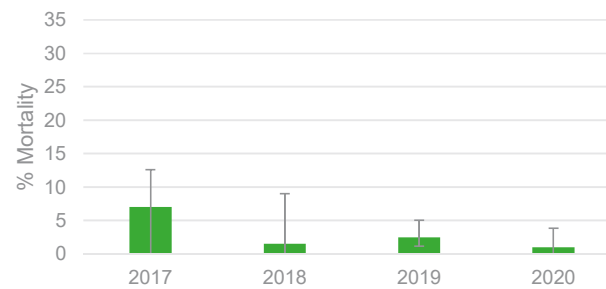
East-Flanders



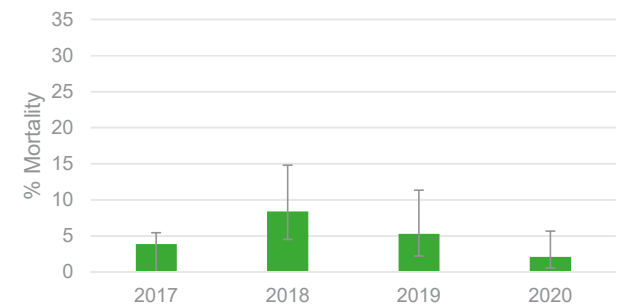
Flemish-Brabant



Limbourg

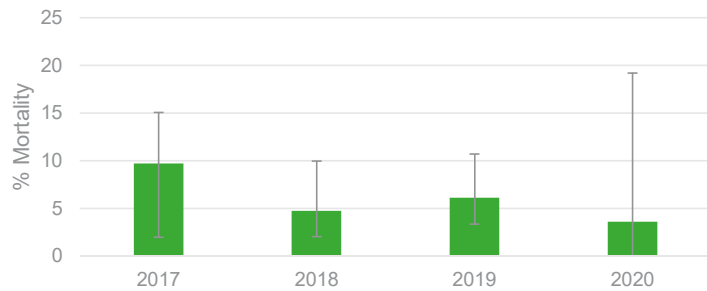


West-Flanders

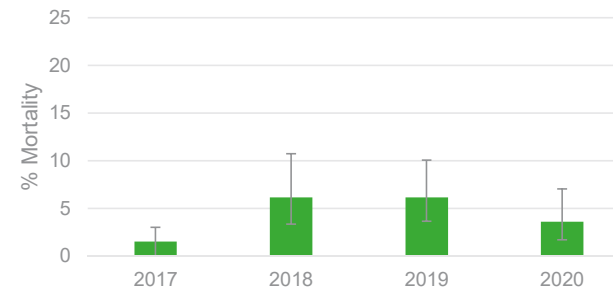


Seasonal Mortality: Walloon provinces

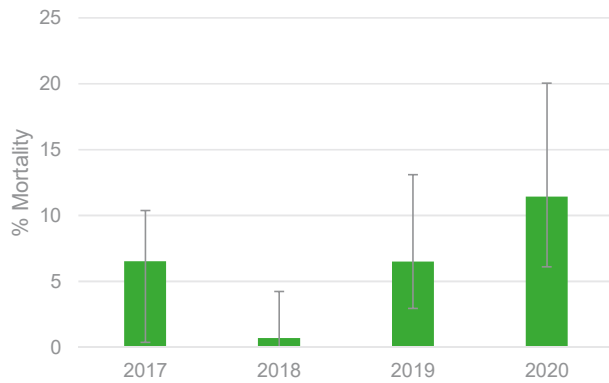
Hainaut



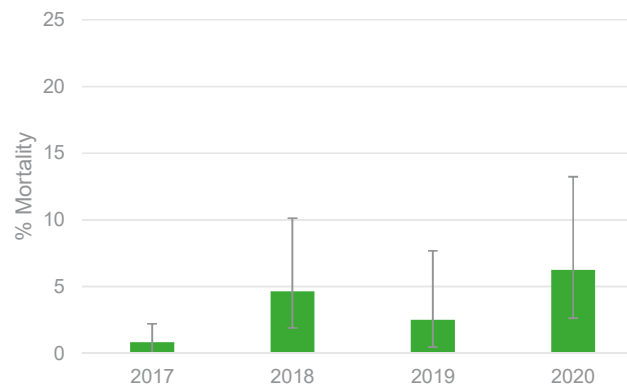
Liege



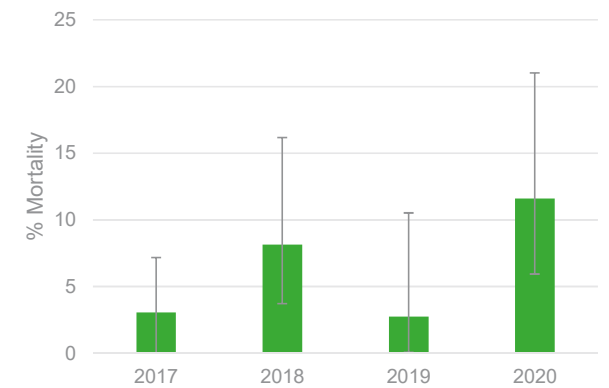
Luxembourg



Namur



Walloon Brabant

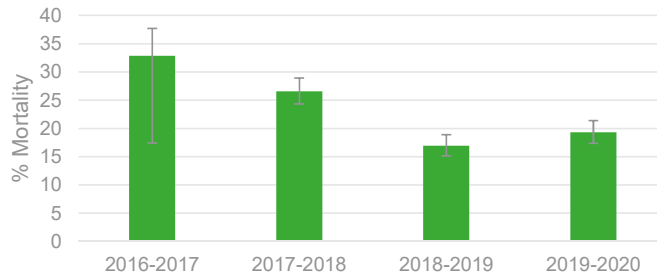


Year Mortality

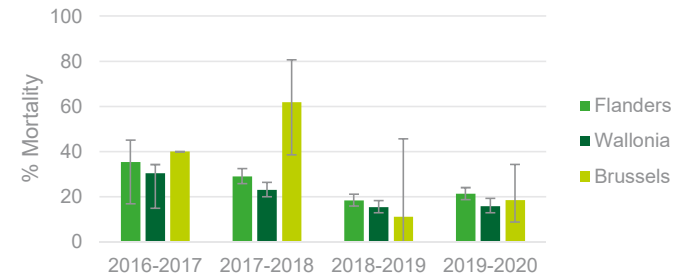
Yearly weighted colony mortality from Fall to Summer											
Geographical entity	Number of sampled apiaries	Number of sampled colonies	Estimated mortality								
			2016-2017		2017-2018		2018-2019		2019-2020		
			%	95% CI	%	95% CI	%	95% CI	%	95% CI	
Belgium	165	735	32.82	17.40 - 27.68	26.56	24.32-28.92	16.94	15.15-18.9	19.29	17.35	21.4
Brussels	4	16	40	NA	61.76	38.53-80.66	11.11	0 - 45.67	18.52	8.79	34.32
Flanders	91	406	35.36	16.87 - 35.04	29	25.81-32.40	18.31	15.83 - 21.07	21.25	18.72	24.01
Antwerp	23	101	30.72	9.31 - 38.75	15.91	11.21-22.07	13.25	9.19 - 18.7	31.96	27.21	37.1
East-Flanders	23	104	54.82	19.77 - 67.66	16.67	11.40-23.66	29.71	21.29 - 40.16	15.64	10.81	22.05
Limburg	18	91	22.78	6.97 - 23.97	9.74	4.32 - 19.66	11.51	8.26 - 15.8	8.06	4.94	12.76
Flemish Brabant	6	25	32.38	11.34 - 40.75	57.91	51.26-64.29	27.58	20.37 - 36.16	32.95	20.87	47.77
West Flanders	21	85	32.51	13.91 - 41.88	21.42	15.05-29.53	25.62	18.64 - 34.1	17.76	12.77	24.14
Wallonie	70	313	30.38	14.85 - 24.21	23.02	19.99-26.36	15.36	12.86 - 18.25	15.8	12.87	19.25
Hainaut	5	23	29.34	15.36 - 37.59	28.11	21.17-36.27	17.22	12.37 - 23.43	46.07	29.22	63.87
Liege	23	93	20.24	3.78 - 27.50	13.06	8.87 -18.83	10.74	7.34 - 15.41	10.08	6.7	14.82
Luxembourg	16	74	38.96	10.34 - 47.20	28.03	21.30-35.91	17.17	11.08 - 25.55	15.5	9.22	24.74
Namur	15	68	28.25	8.39 - 39.19	25.94	19.00-34.33	14.58	9.12 - 22.39	13.75	8.11	22.17
Walloon Brabant	11	55	36.23	12.05 - 45.22	23.48	15.79-33.40	4.23	0.88 - 12.54	24.22	15.86	35.1

Yearly Mortality

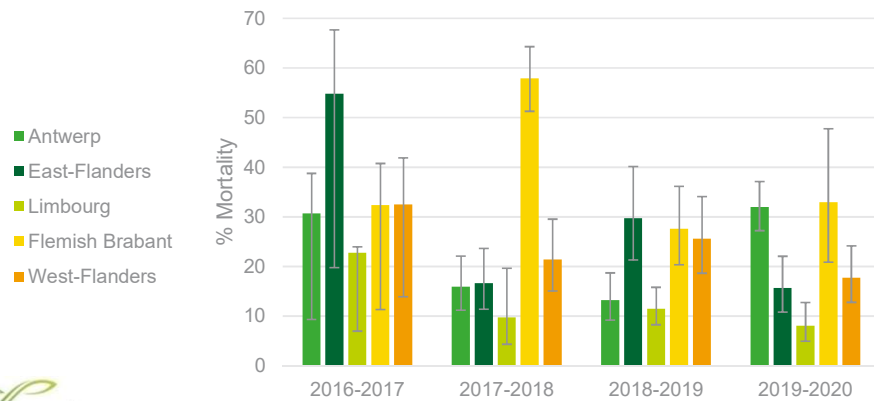
Belgium



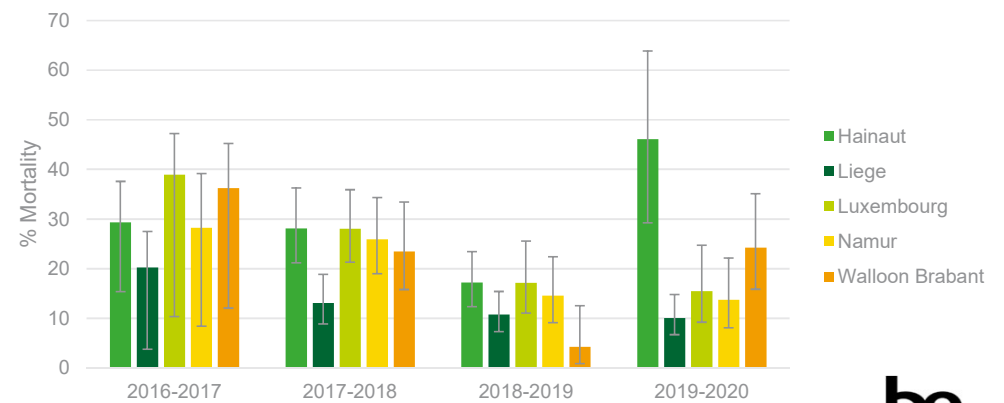
Regions



Flemish Provinces

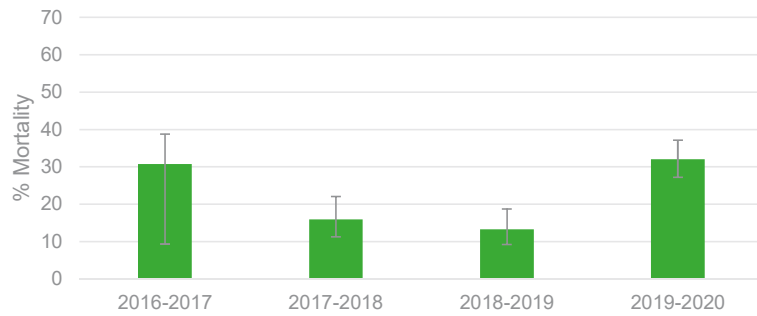


Walloon Provinces

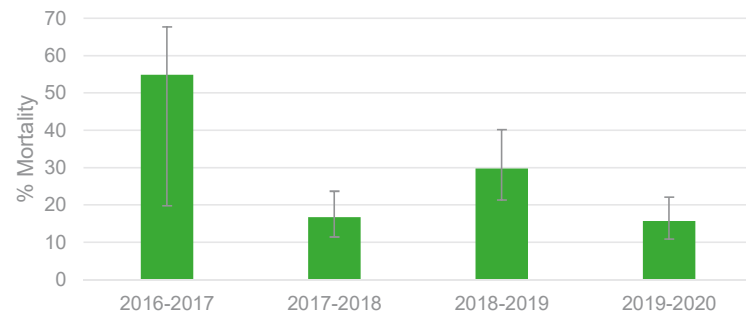


Yearly Mortality: Flemish provinces

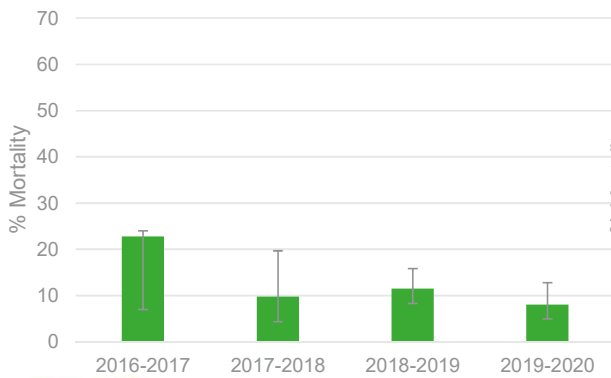
Antwerp



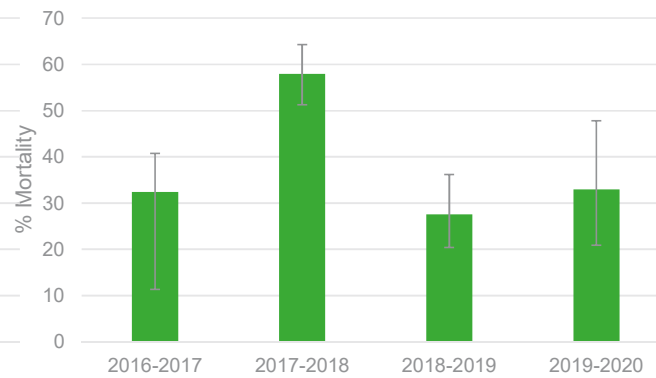
East-Flanders



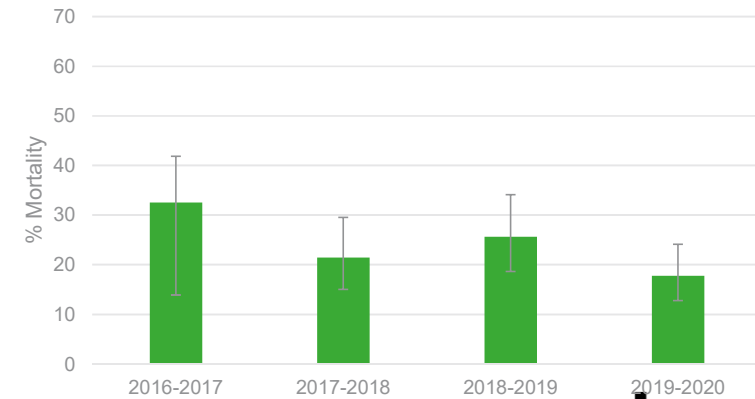
Limbourg



Flemish-Brabant

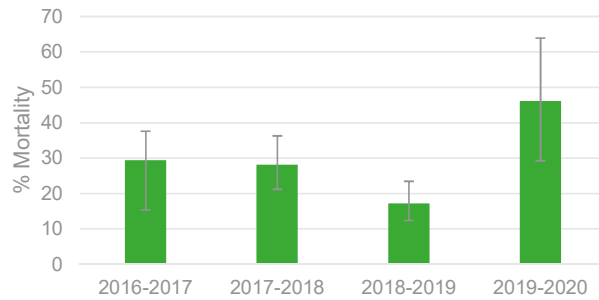


West-Flanders

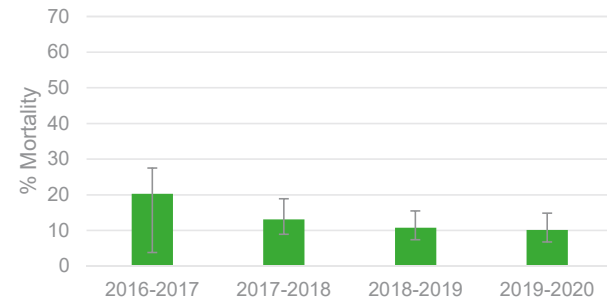


Yearly Mortality: Walloon provinces

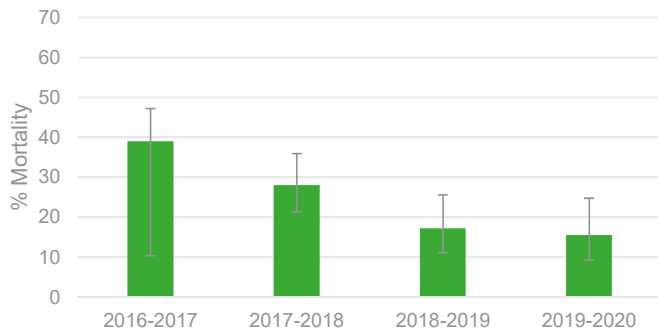
Hainaut



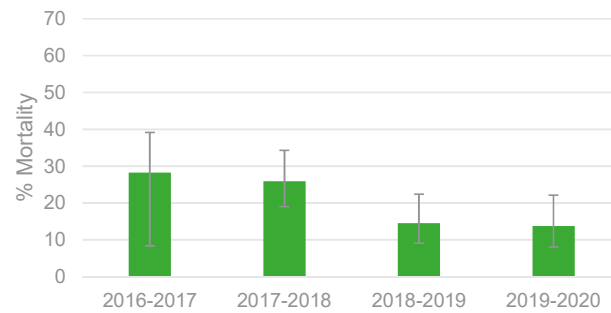
Liege



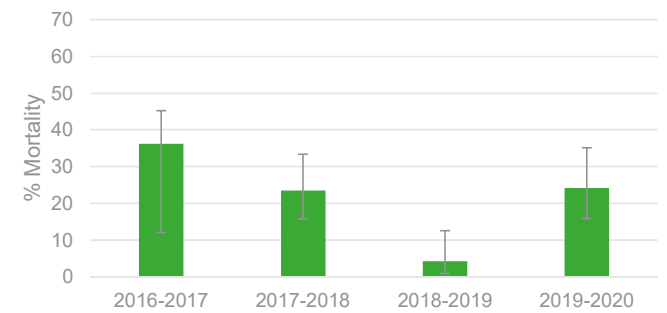
Luxembourg



Namur



Walloon Brabant





- Winter mortality since 2012 :

- 2012-2013: 32.4% (95% CI: 25.4-39.3)
- 2013-2014: 14.8% (95% CI: 11.4-18.3)
- 2016-2017: 29.3% (95% CI: 23.2-36.0)
- 2017-2018: 23.8% (95% CI: 21.6-26.1)
- 2018-2019: 14.7 % (95% CI: 10.8-18.7)
- 2019-2020: 18.2% (95% CI: 16.3-20.2)

**Thank you for your
attention.**