National Herd Reproductive Performance Report

1997 to 2019

John Morton
Jemora Pty Ltd

John Morton

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Jemora Pty Ltd
PO Box 5010
East Geelong VIC 3219
0407 092 558

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SUMMARY

The aim of this ongoing project is to monitor reproductive performance trends nationally using summary statistics from analyses of all suitable data in the Australian Dairy Herd Improvement Scheme (ADHIS) and DataGene databases.

This is an inexpensive national monitoring system. However, the results for each year are based on a relatively small and potentially biased subset of all Australian herds. A key point of concern is the marked decline in numbers of mating periods available for analyses, from 872 in 2014 to only 440 in 2019. Furthermore, numbers of herds with actual in-calf rates (ie rates based on early rectal pregnancy test results) also declined progressively from 2014 to 2019 (Table 2). In 2019, actual 6-week or 100-day in-calf rates were available for only 149 mating periods (Table 2), with in-calf rates for the remaining 291 herds being estimated from calving and insemination data. If this monitoring system is to remain useful, it will be necessary to markedly increase the number of herds with complete early pregnancy testing data in the DataGene databases. In the interim, considerable caution is required when inferring changes in the national herd based on these results.

Despite these serious limitations, some conclusions are possible. Across herds that contributed to these analyses collectively, long-term declines in in-calf rates and submission rates plateaued from approximately 2008 and there is some evidence that 100-day in-calf rates in year-round calving herds improved since 2008. These results also provide evidence that 6-week in-calf rates in 2018 and 2019 were generally a little higher than in recent previous years.

There was large variation in reproductive performance between herds within years; this variation is large relative to the magnitude of the long term decline, and indicates that high reproductive performance is possible. Both non-genetic and genetic factors contribute to reproductive performance so temporal trends reflect the combined effects of any changes in both non-genetic and genetic factors.

ACKNOWLEDGEMENTS

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INTRODUCTION

Previous analyses have identified a long-term decline in reproductive performance in the Australian dairy industry, but also large variation in reproductive performance between herds.

Both non-genetic and genetic factors probably contributed to this decline in reproductive performance. Before 2004, there was no direct genetic selection pressure on sires for daughter fertility in the Australian Proft Ranking (although survival was included and this will have captured some of the genetic determinants of daughter fertility). Due to the negative genetic correlation between milk yield and fertility, with continued long-term selection for milk yield but not for fertility, daughter fertility breeding values declined.

Less rapid declines and possibly increases in reproductive performance would be expected in recent years. The daughter fertility Australian Breeding Value was first included in the Australian Proft Ranking in 2004. As many sires are selected based on the Australian Proft Ranking, over time, less rapid decline in lactating herd reproductive performance would be expected. This change would be expected to have commenced in 2007, the first year that heifers parented by sires selected in 2004 would have entered lactating herds. The reliability of the daughter fertility Australian Breeding Values has been progressively improved since then, increasing the expected fertility response to selection. In 2015, the Australian Proft Ranking was replaced by the Balanced Perfomance Index, and two further alternative indices were also introduced at that time, the Health Weighted Index and the Type Weighted Index. The daughter fertility breeding value was included in all three indices with various weightings.

There are other possible reasons for expecting less rapid declines in reproductive performance in recent years. Herd managers may tolerate herd reproductive performance declines until the consequences become relatively large and obvious, triggering management changes to increase performance. The InCalf extension program may have facilitated such changes. In addition, it is possible that marginal increases in herd reproductive performance are relatively difficult to achieve when herd reproductive performance is high, but these are easier to achieve when herd reproductive performance is lower.

NatSCAN provides a cheap source of data for monitoring reproductive performance in Australia. Under NatSCAN, each year, all herds with suitable data in the ADHIS/DataGene database are analysed using Fertility Focus software. Where the herd does not have adequate early rectal pregnancy testing data, 6-week in-calf rate is estimated using a regression equation developed from the orginal InCalf research dataset. This equation is inferior to 6-week in-calf rates calculated from early rectal pregnancy testing data. However, NatSCAN results can be generated at minimal cost for a relatively large number of herds, so changes in reproductive performance could be assessed at little marginal cost using these data.

The aims of this project were to analyse reproductive performance trends using national data from the ADHIS/DataGene NatSCAN analyses from 1997 to 2019.

All analyses were to be restricted to lactating cows and conducted at the herd-mating period level (rather than at cow or lactation level).

MATERIALS AND METHODS

NatSCAN data were supplied by ADHIS and DataGene annually for analyses conducted for each of 1997 to 2019. These were calculated using the Fertility Focus software. Each record in these data represented one mating period in one herd or, for year-round calving herds, a 12-month period of calvings. For each set of analyses, Fertility Focus selected the most recent mating period (or, for year-round calving herds, the most recent 12-month period of calvings) with adequate data for analysis in each herd. Typically, NatSCAN analyses were conducted by ADHIS/DataGene in November of each year, analysing the previous calendar year's data (and earlier data if necessary). This delay was to allow time for data transfer from data processing centres to ADHIS/DataGene. Mating periods commencing in 2020 were not analysed as, for many herds, the final necessary data for the 2020 mating periods may not have transferred to DataGene by November 2020.

Analyses by year used calendar year of mating start date or, for year-round calvinng herds, intended calendar year of analysis. For seasonal and split calving herds, data for calvings from 1st January to 31st December of the year preceding the analysis date were assessed. If data for that period were adequate for analyses, the most recent mating start date based on those calvings was selected. If data for that period were not adequate for analyses, the 12-month period of calvings commencing one month prior was assessed; this procedure was continued until the most recent 12-month period with adequate data was identified and the most recent mating start date based on those calvings was selected. For simplicity, results for seasonal and split calving herds calving herds were ascribed to the intended year of analysis.

Similarly, for year-round calving herds, the intended year of analysis was the 12-month period of calvings from 1st January to 31st December of the year preceding the analysis date. If data for that period were not adequate for analyses, the 12-month period of calvings commencing one month prior was assessed; this procedure was continued until the most recent 12-month period with adequate data was identified. The period 1st January to 31st December of the year preceding the analysis date was most commonly selected. Failing that, for most years, the 12-month period commenced no earlier than 1st July of the previous year. Accordingly, for simplicity, results for all 12-month periods for year-round calving herds were ascribed to the intended year of analysis.

Fertility Focus produces three report types based on the quality of data available:

- Detailed report (requires early rectal pregnancy test data with foetal ages recorded for the majority of cows; reports 'actual' 6-week and 100-day in-calf rates)
- Intermediate reports (requires calving and artificial insemination data for the majority of cows; reports 'estimated' 6-week and 100-day in-calf rates based on calving and artificial insemination data)
- Basic reports (requires calving and recalving data for the majority of cows; reports 'estimated' 6-week and 100-day in-calf rates based on calving and recalving data)

Data based on basic reports were discarded.

Because Fertility Focus selected the most recent mating period (or, for year-round calving herds, the most recent 12-month period of calvings) with adequate data for analysis in each herd, the same

period could have been selected when analysing data in subsequent years. So multiple analyses of the same period were identified; for these, results based on the most recent analyses were used and other results for that period discarded. It was also possible for adequate results from multiple mating periods in the same herd commencing in same calendar year to be available. Where this occurred, all were included in analyses.

NatSCAN data for all years were pooled and descriptive analyses performed. Actual and estimated 6-week in-calf rates from seasonal and split calving herds were pooled for analyses, as were actual and estimated 100-day in-calf rates from year-round calving herds.

In 2010, ADHIS determined that some of the data received from data processing centres were no longer compatible with their analysis system, and that this was causing spuriously low conception rates. The data processing centres were asked to correct their data at that time. Accordingly, conception rates over time were graphed only from 2010. Effects of this problem on estimated in-calf rates and submission rates are unclear but it is likely that some of the extremely low estimated in-calf rates and submission rates are spurious and due to this same problem.

RESULTS AND CONCLUSIONS

NUMBERS OF MATING PERIODS

After exclusion of results from 1996 mating periods, basic reports, and repeated analyses of mating periods with the same mating start date, 15,689 mating periods (or, for year–round calving herds, 12-month periods of calvings) from 1997 to 2019 were analysed. The distribution of these by calving system and year is shown in Table 1. A key point of concern is the marked decline in numbers of mating periods available for analyses, from 872 in 2014 to only 440 in 2019. Numbers of herds with actual results also declined progressively from 2014 to 2019 (Table 2). In 2019, actual 6-week or 100-day in-calf rates were available for only 149 mating periods (Table 2), with in-calf rates for the remaining 291 herds being estimated.

In 2019, 49% of mating periods were in split calving herds, 36% in seasonal calving herds and 15% in year-round calving herds. These may differ from the true national distribution as herds submitting data to DataGene may not be representative of all herds in Australia.

Table 1. Distributions of numbers of mating periods (or, for year–round calving herds, 12-month periods of calvings) analysed by calving system and year

Year	Seasonal		Split		Year-round		Total
1997	669	86%	64	8%	46	6%	779
1998	647	84%	71	9%	49	6%	767
1999	695	79%	104	12%	79	9%	878
2000	552	69%	111	14%	138	17%	801
2001	625	69%	153	17%	124	14%	902
2002	536	65%	185	23%	101	12%	822
2003	438	66%	139	21%	89	13%	666
2004	354	60%	150	26%	84	14%	588
2005	349	56%	172	28%	97	16%	618
2006	305	54%	175	31%	84	15%	564
2007	274	52%	181	34%	75	14%	530
2008	289	54%	178	33%	72	13%	539
2009	261	50%	194	37%	69	13%	524
2010	254	49%	197	38%	70	13%	521
2011	246	45%	231	42%	72	13%	549
2012	236	43%	241	44%	76	14%	553
2013	279	34%	385	47%	158	19%	822
2014	281	32%	394	45%	197	23%	872
2015	262	32%	360	44%	196	24%	818
2016	236	30%	374	48%	172	22%	782
2017	227	30%	364	49%	158	21%	749
2018	182	30%	295	49%	128	21%	605
2019	159	36%	215	49%	66	15%	440
Pooled	8,356	53%	4,933	31%	2,400	15%	15,689

Table 2. Distributions of numbers of mating periods (or, for year–round calving herds, 12-month periods of calvings) analysed by year

Year	Seasonal		Split		Year-round		Total
	Actual	Estimated	Actual	Estimated	Actual	Estimated	
1997		669		64		46	779
1998		647		71		49	767
1999		695		104		79	878
2000	19	533	5	106	1	137	801
2001	23	602	9	144		124	902
2002	33	503	24	161	2	99	822
2003	31	407	23	116	3	86	666
2004	33	321	25	125	5	79	588
2005	44	305	39	133	8	89	618
2006	60	245	45	130	3	81	564
2007	63	211	47	134	13	62	530
2008	85	204	63	115	12	60	539
2009	68	193	62	132	11	58	524
2010	58	196	85	112	14	56	521
2011	56	190	81	150	7	65	549
2012	58	178	100	141	15	61	553
2013	94	185	194	191	57	101	822
2014	104	177	210	184	78	119	872
2015	103	159	206	154	83	113	818
2016	80	156	187	187	65	107	782
2017	80	147	164	200	45	113	749
2018	56	126	136	159	25	103	605
2019	42	117	93	122	14	52	440
Pooled	1,190	7,166	1,798	3,135	461	1,939	15,689

6-WEEK IN-CALF RATES (SEASONAL AND SPLIT CALVING HERDS)

Six-week in-calf rates describe the proportion of lactations where the cow became pregnant by the end of the 6th week after mating start date. Distributions of 6-week in-calf rates (pooled actual and estimated 6-week in-calf rates from seasonal and split calving herds) by year are shown in Table 3 and Figure 1.

Within each year, there were large variations in 6-week in-calf rates between herds, indicating that high reproductive performance is possible. Median six-week in-calf rates declined to 2008 then generally plateaued. There is limited evidence from Table 3 and Figure 1 that there may have been a small overall increase in 6-week in-calf rates in 2018 and 2019 relative to the immediately preceding years.

Within each year, all eligible herds were used and the populations of herds used differed between years. To allow comparisons between years using the same herds, rolling 4-year cohorts were also created; each cohort consisted of all herds with 6-week in-calf rates in each of the four consecutive years. Median 6-week in-calf rates for these cohorts are shown in Table 4 and Figure 2. These results provide further evidence that 6-week in-calf rates in 2018 and 2019 were generally a little higher than in recent previous years.

Medians for four-year cohorts were greater than medians for all herds in the same year, indicating that herds consistently supplying reproductive data to DataGene have better reproductive performance, on average, than herds supplying such data less consistently or over shorter periods.

Table 3. Distributions of 6-week in-calf rates for seasonal and split calving herds (pooled) from 1997 to 2019

Year	No. mating periods included	Minimum	25th percentile	Median	75th percentile	Maximum
1997	733	19	50	57	63	75
1998	718	16	48	56	62	76
1999	799	20	50	57	63	78
2000	663	5	47	56	63	76
2001	778	4	49	56	62	82
2002	721	3	46	54	60	73
2003	577	1	44	53	60	78
2004	504	1	44	54	59.5	74
2005	521	1	43	52	60	76
2006	480	1	43	52	61	83
2007	455	1	39	51	59	77
2008	467	1	34	48	57	92
2009	455	1	37	49	59	75
2010	451	5	42	52	59	86
2011	477	2	43	53	60	84
2012	477	2	43	51	60	82
2013	664	3	40	50	58	83
2014	675	1	41	50	60	85
2015	622	1	40	49	58	87
2016	610	1	41	50	58	90
2017	591	3	40	50	60	84
2018	477	7	42	51	59	87
2019	374	6	42	51	59	81

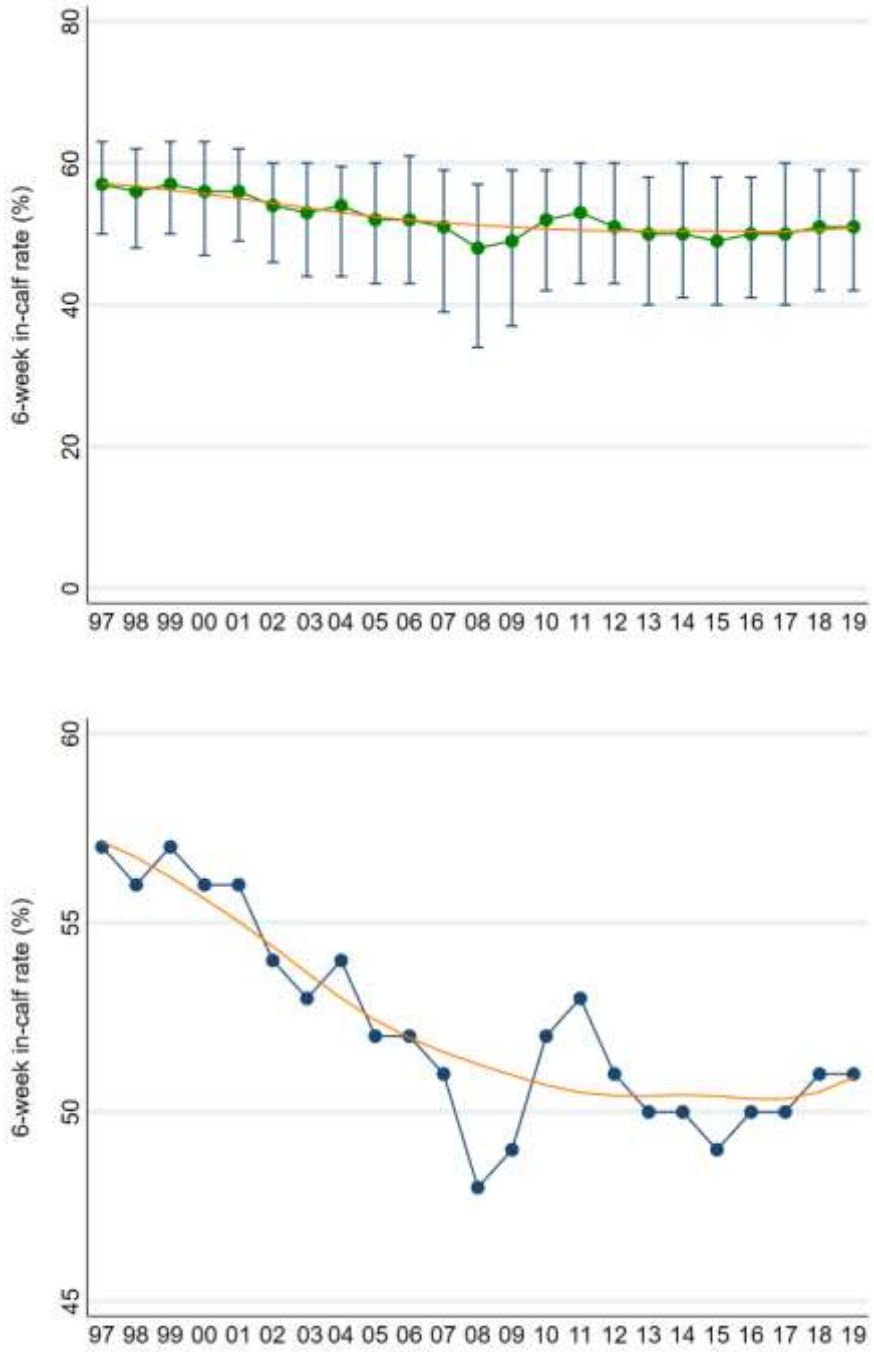

Figure 1. Median 6-week in-calf rates for mating periods in seasonal and split calving herds (pooled) from 1997 to 2019; both graphs are identical other than the reduced y-axis range in the lower graph and the error bars in upper graph indicating 25th and 75th percentiles within years; the orange line is the lowess (locally weighted regression) line of best fit through the medians.

Table 4. Median 6-week in-calf rates for seasonal and split calving herds (pooled) by rolling 4-year cohorts from 1997 to 2019

Cohort years[1]	Year	No. herds	Median
97-00	1997	278	58%
97-00	1998	278	59%
97-00	1999	278	60%
97-00	2000	278	59%
98-01	1998	268	58%
98-01	1999	268	59%
98-01	2000	268	58%
98-01	2001	268	58%
99-02	1999	267	59%
99-02	2000	267	59%
99-02	2001	267	58%
99-02	2002	267	56%
00-03	2000	218	58%
00-03	2001	218	58%
00-03	2002	218	56%
00-03	2003	218	55%
01-04	2001	211	57%
01-04	2002	211	56%
01-04	2003	211	54%
01-04	2004	211	55%
02-05	2002	215	55%
02-05	2003	215	55%
02-05	2004	215	55%
02-05	2005	215	54%
03-06	2003	201	55%
03-06	2004	201	55%
03-06	2005	201	55%
03-06	2006	201	53%
04-07	2004	186	55%
04-07	2005	186	55%
04-07	2006	186	55%
04-07	2007	186	53%
05-08	2005	180	55%
05-08	2006	180	54%
05-08	2007	180	53%
05-08	2008	180	50%
06-09	2006	166	53%
06-09	2007	166	53%
06-09	2008	166	51%
06-09	2009	166	53%
07-10	2007	158	53%
07-10	2008	158	49%
07-10	2009	158	53%
07-10	2010	158	52%
08-11	2008	178	48%
08-11	2009	178	51%
08-11	2010	178	52%
08-11	2011	178	54%
09-12	2009	201	52%
09-12	2010	201	54%
09-12	2011	201	54%

Table 4 (continued). Median 6-week in-calf rates for seasonal and split calving herds (pooled) by rolling 4-year cohorts from 1997 to 2019

Cohort years[1]	Year	No. herds	Median
09-12	2012	201	52%
10-13	2010	219	54%
10-13	2011	219	55%
10-13	2012	219	52%
10-13	2013	219	52%
11-14	2011	201	56%
11-14	2012	201	53%
11-14	2013	201	52%
11-14	2014	201	52%
12-15	2012	215	53%
12-15	2013	215	52%
12-15	2014	215	53%
12-15	2015	215	51%
13-16	2013	279	52%
13-16	2014	279	52%
13-16	2015	279	50%
13-16	2016	279	51%
14-17	2014	277	51%
14-17	2015	277	50%
14-17	2016	277	50%
14-17	2017	277	52%
15-18	2015	228	50%
15-18	2016	228	50%
15-18	2017	228	52%
15-18	2018	228	52%
16-19	2016	190	52%
16-19	2017	190	53%
16-19	2018	190	53%
16-19	2019	190	53%

[1]For example, '97-00' indicates the cohort of herds that had actual or estimated 6-week in-calf rates for mating periods commencing in each year from 1997 to 2000.

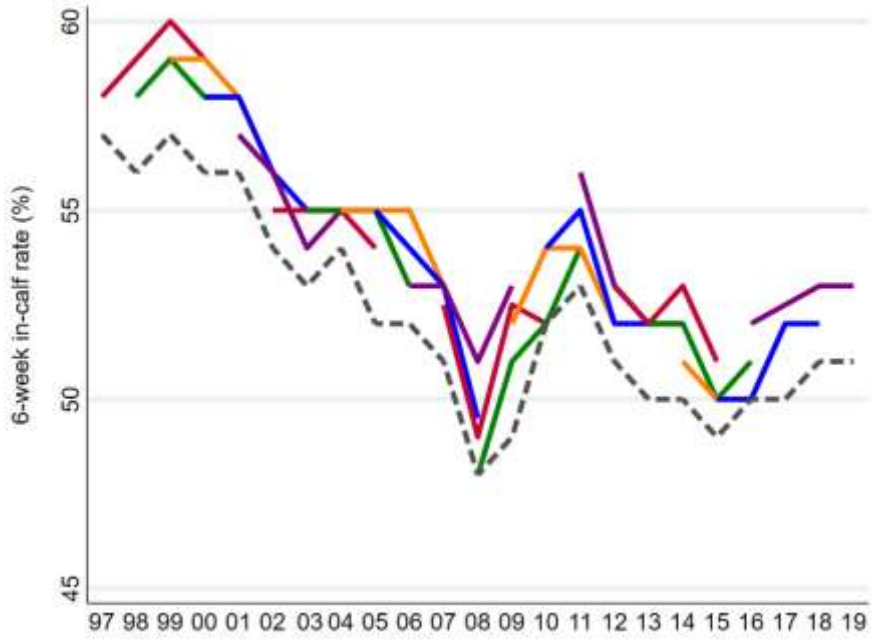

Figure 2. Median 6-week in-calf rates for seasonal and split calving herds (pooled) by rolling 4-year cohorts from 1997 to 2019; 4-year cohorts are sequentially coloured red, green, orange, blue, and purple then this colour sequence is repeated; dashed line shows medians for all herds (also shown in Figure 1).

In the analyses above, seasonal and split calving herds were pooled. Below results are reported for these separately (Table 5 and Figure 3). Patterns over time were similar for seasonal and split calving herds.

Table 5. Distributions of 6-week in-calf rates for seasonal and split calving herds (separately) from 1997 to 2019

Year	No. mating periods included	Minimum	25th percentile	Median	75th percentile	Maximum
Seasonal calving herds						
1997	669	19%	50%	57%	63%	75%
1998	647	16%	48%	56%	62%	76%
1999	695	20%	50%	57%	63%	78%
2000	552	12%	48%	56%	63%	76%
2001	625	4%	48%	56%	62%	82%
2002	536	3%	45%	54%	61%	73%
2003	438	1%	44%	53%	60%	78%
2004	354	1%	44%	53%	59%	74%
2005	349	1%	43%	53%	60%	76%
2006	305	1%	42%	52%	61%	80%
2007	274	1%	37%	50%	58%	77%
2008	289	1%	34%	47%	57%	92%
2009	261	1%	38%	49%	59%	75%
2010	254	6%	44%	52%	62%	79%
2011	246	2%	44%	54%	60%	84%
2012	236	2%	44%	53%	60%	82%
2013	279	3%	41%	51%	59%	83%

Table 5 (continued). Distributions of 6-week in-calf rates for seasonal and split calving herds (separately) from 1997 to 2019

Year	No. mating periods included	Minimum	25th percentile	Median	75th percentile	Maximum
2014	281	1%	42%	50%	61%	85%
2015	262	2%	42%	51%	61%	87%
2016	236	4%	42%	51%	60%	89%
2017	227	11%	41%	51%	61%	79%
2018	182	7%	43%	52%	62%	87%
2019	159	17%	43%	52%	61%	81%
Split calving herds						
1997	64	27%	48%	57%	61%	69%
1998	71	33%	48%	55%	61%	72%
1999	104	26%	50%	57%	62%	70%
2000	111	5%	43%	54%	61%	71%
2001	153	8%	50%	56%	62%	73%
2002	185	4%	48%	53%	60%	73%
2003	139	2%	45%	53%	61%	70%
2004	150	1%	45%	55%	60%	74%
2005	172	1%	40%	52%	59%	73%
2006	175	1%	43%	52%	60%	83%
2007	181	1%	40%	53%	60%	74%
2008	178	1%	35%	49%	58%	71%
2009	194	1%	37%	49%	58%	73%
2010	197	5%	40%	50%	58%	86%
2011	231	16%	43%	52%	60%	76%
2012	241	6%	40%	50%	58%	76%
2013	385	8%	40%	50%	57%	78%
2014	394	1%	40%	50%	58%	76%
2015	360	1%	38%	48%	56%	78%
2016	374	1%	40%	49%	57%	90%
2017	364	3%	40%	49%	59%	84%
2018	295	7%	41%	51%	58%	79%
2019	215	6%	41%	50%	58%	78%

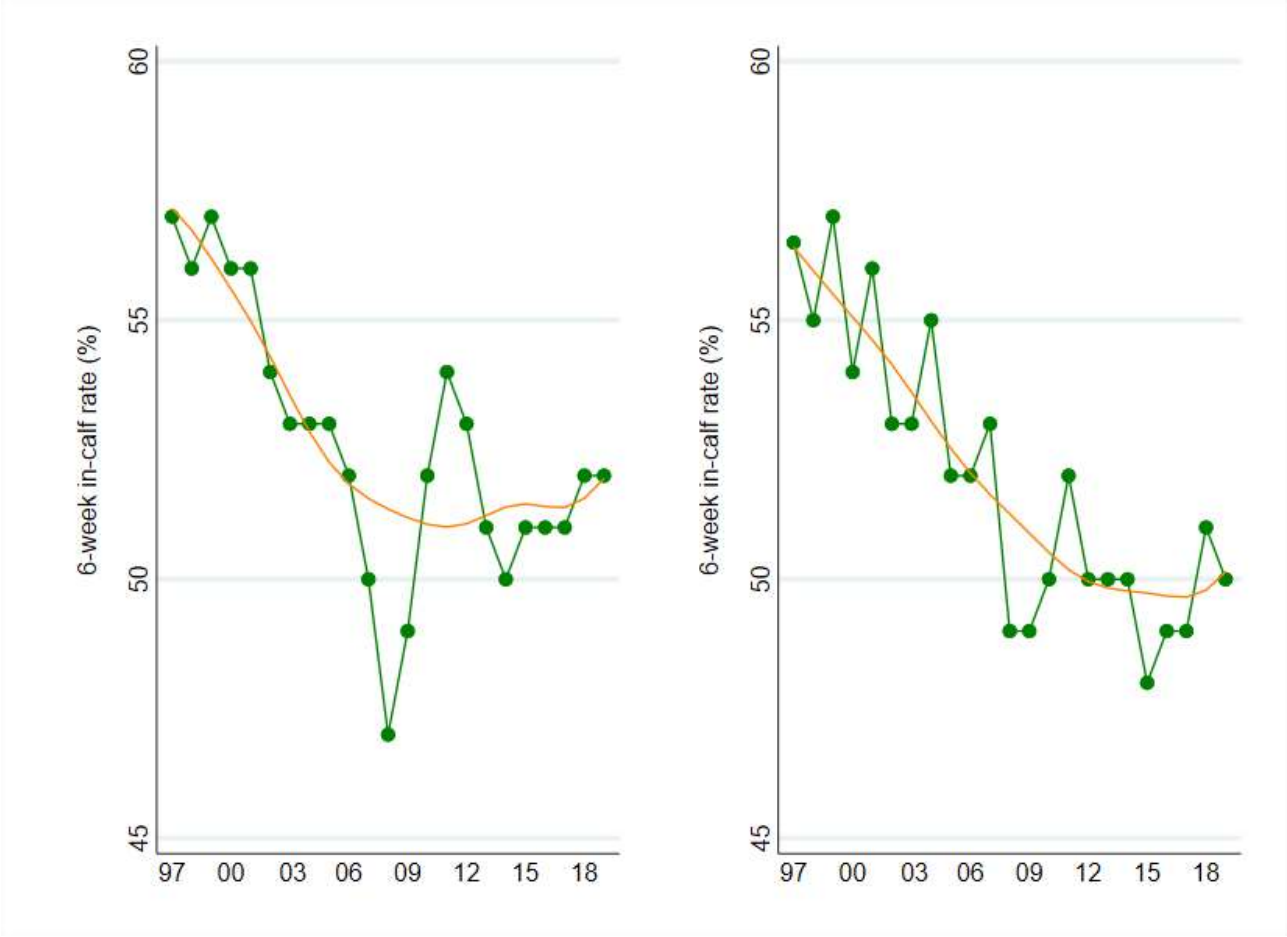

Figure 3. Median 6-week in-calf rates for mating periods in seasonal (left-hand graph) and split (right-hand graph) calving herds from 1997 to 2019; the orange lines are the lowess (locally weighted regression) lines of best fit through the medians.

In all analyses reported above, estimated and actual 6-week in-calf rates and 100-day in-calf rates were pooled and analysed. Further analyses were also performed restricted to actual 6-week in-calf rates from seasonal and split calving herds (pooled) from 2012 to 2019. Distributions of 6-week in-calf rates by year are shown in Table 6. The extremely low values are implausible and are probably due to incomplete or inaccurate data. These results provide further evidence that 6-week in-calf rates in 2019 were generally a little higher than in recent previous years.

Table 6. Distributions of actual 6-week in-calf rates for seasonal and split calving herds (pooled) from 2012 to 2019

Year	No. mating periods included	Minimum	25th percentile	Median	75th percentile	Maximum
2012	158	2%	35%	45%	55%	82%
2013	288	3%	33%	44%	54%	83%
2014	314	1%	35%	45%	55%	85%
2015	309	1%	32%	44%	53%	87%
2016	267	1%	35%	44%	52%	90%
2017	244	3%	34%	45%	53%	84%
2018	192	7%	36%	44%	55%	87%
2019	135	6%	38%	49%	57%	81%

100-DAY IN-CALF RATES (YEAR-ROUND CALVING HERDS)

One hundred day in-calf rates describe the proportion of lactations where the cow became pregnant by the 100th day after her calving. Distributions of 100-day in-calf rates (actual and estimated pooled) by year are shown in Table 7 and Figure 4. Results for rolling 4-year cohorts are shown in Table 8 and Figure 5.

Within each year, there were large variations in 100-day in-calf rates between herds, indicating that high reproductive performance is possible. Median 100-day in-calf rates declined to 2008 then plateaued before increasing more recently. The apparent decline in 2019 is difficult to interpret given the large reduction in number of herds with suitable data for analyses, down from 197 in 2014 and 128 in 2018 to only 66 in 2019. For 100-day in-calf rates, each 4-year cohort consisted of relatively few herds and two recent rolling 4-year cohorts (2011-2014 and 2012-2015) had only 23 and 19 herds and so were not reliable descriptors of all year-round calving herds. Disregarding these cohorts, results from the rolling 4-year cohorts showed the same general patterns as for all herds. Again, the apparent decline in 2019 is difficult to interpret given the large reduction in number of herds with suitable data for analyses; the 2019 result in Table 8 and Figure 5 is based on a 4-year cohort of only 31 herds.

Table 7. Distributions of 100-day in-calf rates for year-round calving herds from 1997 to 2019

Year	No. 12-month calving periods included	Minimum	25th percentile	Median	75th percentile	Maximum
1997	46	20%	30%	39%	47%	58%
1998	49	16%	29%	35%	43%	60%
1999	79	6%	21%	28%	38%	54%
2000	138	2%	27%	34%	40%	67%
2001	124	9%	26%	35%	40%	60%
2002	101	6%	26%	31%	38%	57%
2003	89	4%	24%	28%	33%	47%
2004	84	1%	21%	30%	35%	49%
2005	97	6%	22%	31%	37%	56%
2006	84	4%	24%	32%	40%	53%
2007	75	1%	22%	30%	38%	54%
2008	72	4%	19%	29%	36%	59%
2009	69	1%	23%	30%	36%	51%
2010	70	7%	23%	31%	36%	57%
2011	72	4%	22%	29%	37%	56%
2012	76	5%	24%	30%	38%	58%
2013	159	1%	22%	30%	37%	63%
2014	197	8%	26%	33%	39%	66%
2015	196	11%	28%	34%	41%	58%
2016	172	11%	27%	34%	40%	62%
2017	158	9%	28%	35%	40%	60%
2018	128	9%	27%	34%	41%	58%
2019	66	12%	27%	32%	41%	60%

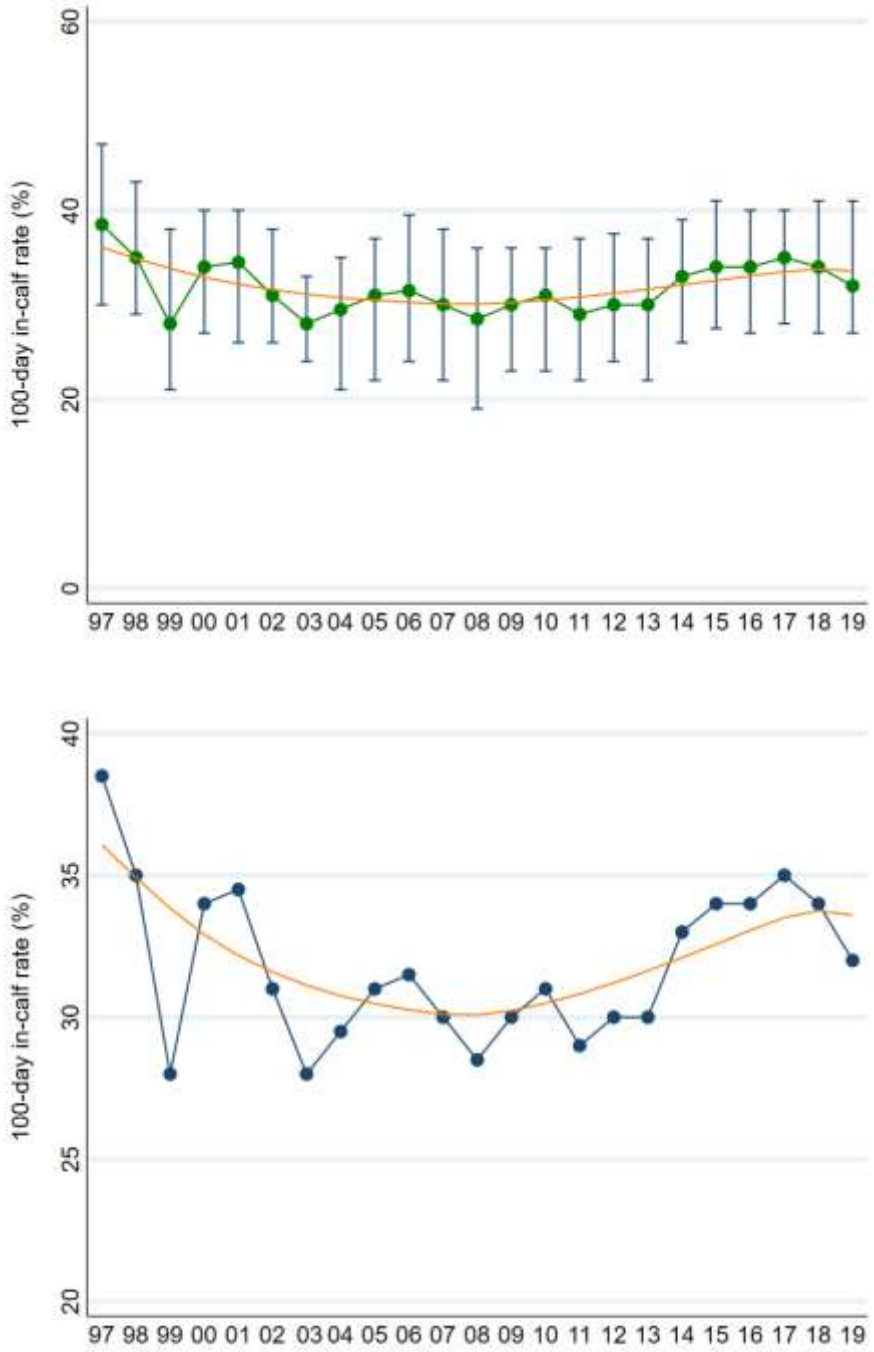

Figure 4. Median 100-day in-calf rates for year-round calving herds from 1997 to 2019; both graphs are identical other than the reduced y-axis range in the lower graph and error bars in the upper graph indicating 25th and 75th percentiles within years; the orange line is the lowess (locally weighted regression) line of best fit through the medians.

Table 8. Median 100-day in-calf rates for year-round calving herds by rolling 4-year cohorts from 1997 to 2019

Cohort years[1]	Year	No. herds	Median
97-00	1997	18	41%
97-00	1998	18	39%
97-00	1999	18	39%
97-00	2000	18	35%
98-01	1998	16	39%
98-01	1999	16	41%
98-01	2000	16	39%
98-01	2001	16	39%
99-02	1999	35	28%
99-02	2000	35	36%
99-02	2001	35	35%
99-02	2002	35	30%
00-03	2000	52	37%
00-03	2001	52	38%
00-03	2002	52	33%
00-03	2003	52	28%
01-04	2001	39	38%
01-04	2002	39	34%
01-04	2003	39	28%
01-04	2004	39	32%
02-05	2002	34	34%
02-05	2003	34	29%
02-05	2004	34	32%
02-05	2005	34	32%
03-06	2003	30	29%
03-06	2004	30	32%
03-06	2005	30	32%
03-06	2006	30	33%
04-07	2004	29	31%
04-07	2005	29	31%
04-07	2006	29	33%
04-07	2007	29	34%
05-08	2005	28	30%
05-08	2006	28	34%
05-08	2007	28	35%
05-08	2008	28	33%
06-09	2006	29	34%
06-09	2007	29	35%
06-09	2008	29	33%
06-09	2009	29	30%
07-10	2007	27	33%
07-10	2008	27	31%
07-10	2009	27	33%
07-10	2010	27	30%
08-11	2008	31	30%
08-11	2009	31	31%
08-11	2010	31	30%
08-11	2011	31	30%
09-12	2009	30	29%
09-12	2010	30	31%
09-12	2011	30	29%

Table 8 (continued). Median 100-day in-calf rates for year-round calving herds by rolling 4-year cohorts from 1997 to 2019

Cohort years[1]	Year	No. herds	Median
09-12	2012	30	31%
10-13	2010	30	30%
10-13	2011	30	29%
10-13	2012	30	30%
10-13	2013	30	29%
11-14	2011	23	29%
11-14	2012	23	30%
11-14	2013	23	26%
11-14	2014	23	28%
12-15	2012	19	29%
12-15	2013	19	21%
12-15	2014	19	29%
12-15	2015	19	29%
13-16	2013	69	29%
13-16	2014	69	35%
13-16	2015	69	34%
13-16	2016	69	35%
14-17	2014	72	35%
14-17	2015	72	34%
14-17	2016	72	35%
14-17	2017	72	36%
15-18	2015	60	34%
15-18	2016	60	35%
15-18	2017	60	36%
15-18	2018	60	35%
16-19	2016	31	34%
16-19	2017	31	36%
16-19	2018	31	35%
16-19	2019	31	32%

[1]For example, '97-00' indicates the cohort of herds that had actual or estimated 100-day in-calf rates for calvings in each year from 1997 to 2000.

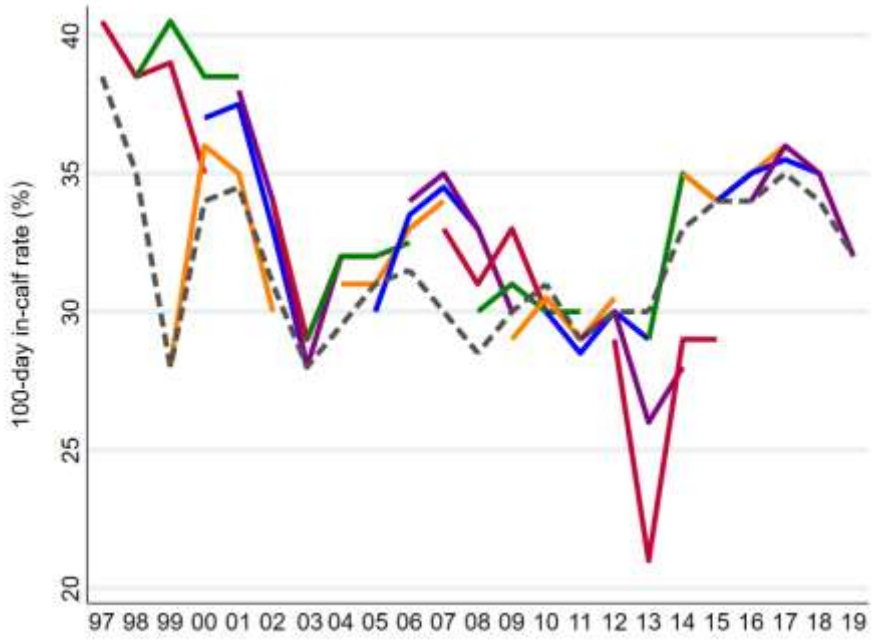

Figure 5. Median 100-day in-calf rates for year-round calving herds by rolling 4-year cohorts from 1997 to 2019; 4-year cohorts are sequentially coloured red, green, orange, blue, and purple then this colour sequence is repeated; dashed line shows medians for all herds (also shown in Figure 4).

3-WEEK SUBMISSION RATES (SEASONAL AND SPLIT CALVING HERDS)

Three-week submission rates describe the proportion of lactations where the cow had received at least one artificial insemination by the end of the 3rd week of the mating period. Distributions of 3-week submission rates from seasonal and split calving herds pooled by year are shown in Table 9 and Figure 6.

Median 3-week submission rates were surprisingly low in all years, possibly due to incomplete or inaccurate data for some herds. Median 3-week submission rates varied substantially by year, limiting the ability of this monitoring system to detect long term temporal trends. Within this limitation, there was no substantial systematic trend in median 3-week submission rates over time.

Table 9. Distributions of 3-week submission rates for seasonal and split calving herds (pooled) from 1997 to 2019

Year	No. mating periods included	Minimum	25th percentile	Median	75th percentile	Maximum
1997	733	3%	51%	64%	73%	95%
1998	718	4%	48%	61%	73%	93%
1999	799	3%	50%	64%	75%	98%
2000	662	2%	47%	62%	74%	98%
2001	773	1%	49%	63%	75%	98%
2002	714	6%	46%	59%	71%	95%
2003	574	4%	45%	59%	72%	94%
2004	499	1%	48%	61%	71%	98%
2005	510	1%	44%	58%	71%	97%
2006	472	3%	48%	63%	74%	99%
2007	442	4%	48%	62%	73%	99%
2008	452	5%	46%	61%	72%	95%
2009	436	7%	45%	59%	72%	91%
2010	434	4%	48%	63%	74%	97%
2011	465	4%	48%	63%	73%	98%
2012	446	4%	48%	62%	72%	96%
2013	635	1%	46%	59%	73%	97%
2014	624	3%	47%	61%	73%	98%
2015	585	7%	47%	62%	73%	95%
2016	572	4%	47%	60%	72%	99%
2017	552	1%	46%	61%	73%	100%
2018	434	2%	48%	60%	71%	99%
2019	347	8%	41%	58%	72%	98%

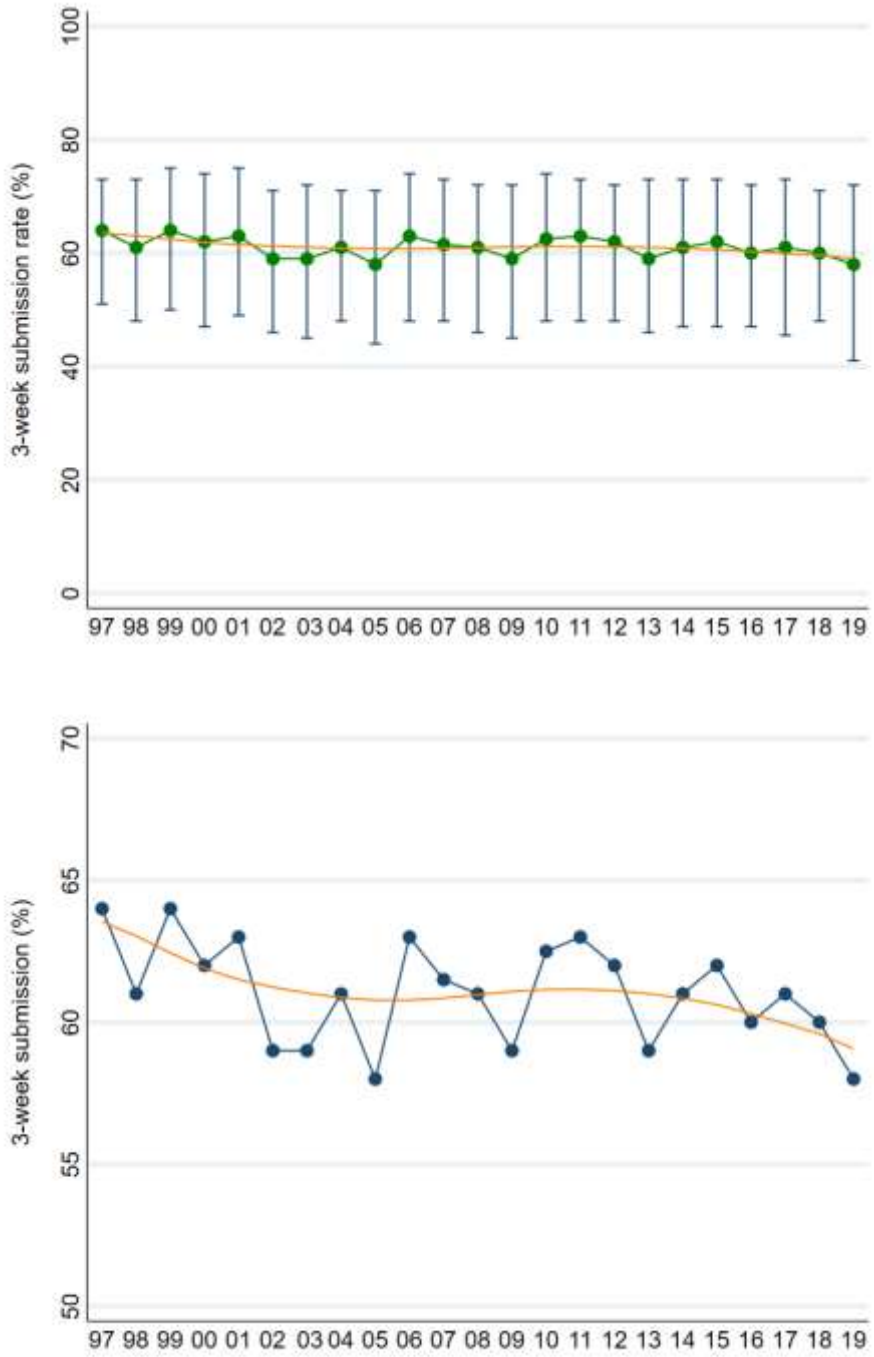

Figure 6. Median 3-week submission rates for seasonal and split calving herds (pooled) from 1997 to 2019; both graphs are identical other than the reduced y-axis range in the lower graph and error bars in the upper graph indicating 25th and 75th percentiles within years; the orange line is the lowess (locally weighted regression) line of best fit through the medians.

80-DAY SUBMISSION RATES (YEAR-ROUND CALVING HERDS)

Eighty-day submission rates describe the proportion of lactations where the cow had received at least one artificial insemination on or before the 80th day after her calving. Distributions of 80-day submission rates from year-round calving herds pooled by year are shown in Table 10 and Figure 7. Median 80-day submission rates declined until 2006 then increased before plateauing from 2015. The apparent decline since 2017 is difficult to interpret given the large reduction in number of herds with suitable data for analyses, down from 190 in 2014 and 126 in 2018 to only 65 in 2019.

Table 10. Distributions of 80-day submission rates for year-round calving herds from 1997 to 2019

Year	No. mating periods included	Minimum	25th percentile	Median	75th percentile	Maximum
1997	46	3%	30%	42%	59%	89%
1998	49	6%	28%	42%	53%	86%
1999	78	1%	17%	29%	43%	82%
2000	137	1%	25%	37%	50%	79%
2001	122	2%	24%	35%	50%	74%
2002	100	1%	23%	33%	48%	66%
2003	89	1%	21%	28%	36%	72%
2004	83	1%	21%	29%	39%	69%
2005	97	1%	22%	30%	43%	80%
2006	82	1%	21%	35%	48%	77%
2007	72	1%	22%	34%	45%	71%
2008	71	1%	17%	27%	45%	79%
2009	66	1%	21%	33%	45%	76%
2010	68	1%	21%	32%	43%	80%
2011	69	1%	20%	31%	43%	81%
2012	74	1%	21%	32%	45%	75%
2013	154	1%	26%	37%	50%	81%
2014	190	2%	28%	41%	51%	86%
2015	187	3%	31%	43%	55%	89%
2016	168	3%	30%	43%	55%	89%
2017	154	2%	30%	42%	56%	93%
2018	126	2%	26%	39%	52%	81%
2019	65	9%	25%	35%	51%	74%

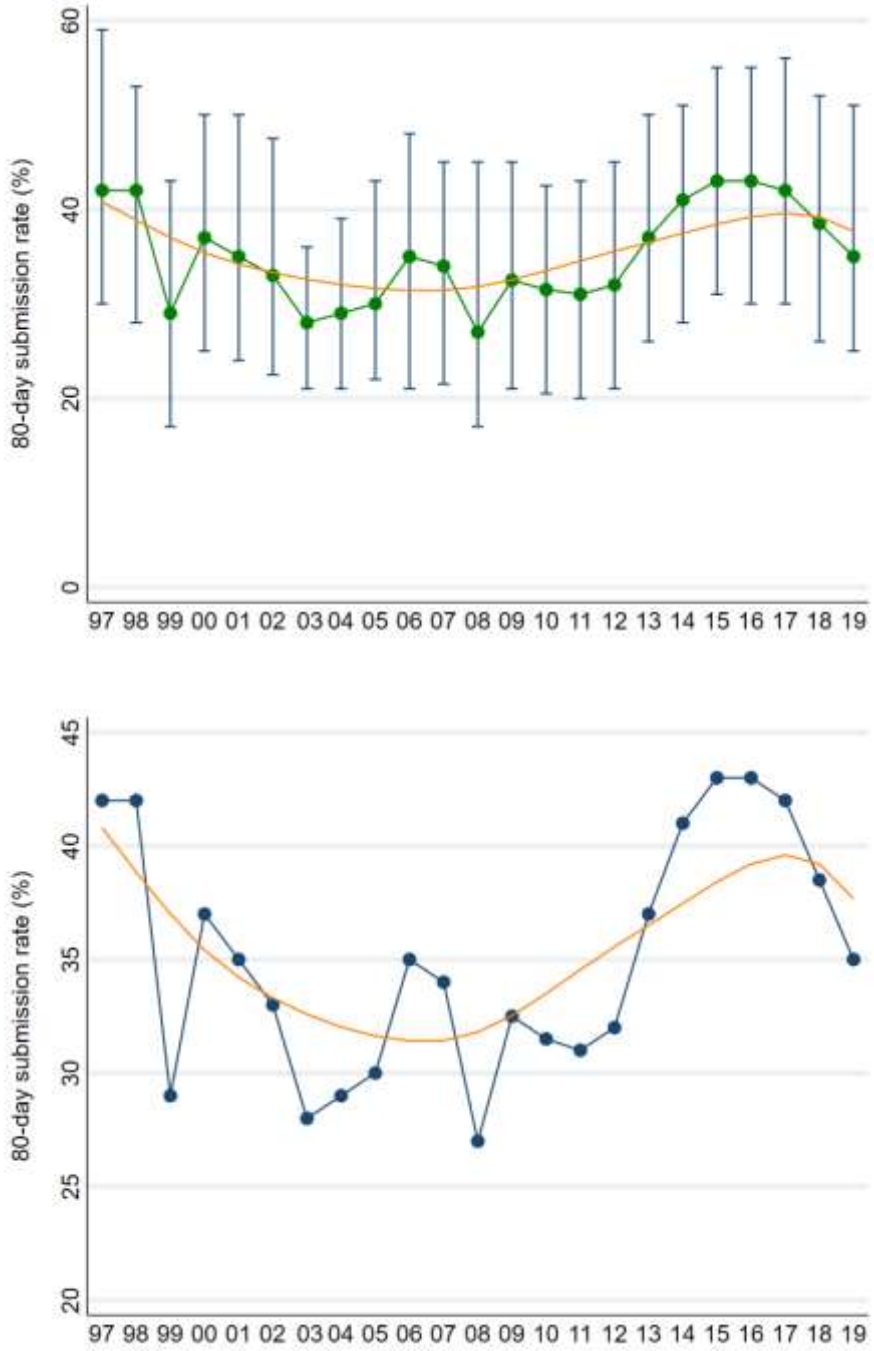

Figure 7. Median 80-day submission rates for year-round calving herds from 1997 to 2019; both graphs are identical other than the reduced y-axis range in the lower graph and error bars in the upper graph indicating 25th and 75th percentiles within years; the orange line is the lowess (locally weighted regression) line of best fit through the medians.

CONCEPTION RATES

Distributions of conception rates for seasonal and split calving herds pooled, and for year-round calving herds, by year are shown in Tables 11 and 12, respectively.

In 2010, ADHIS determined that some of the data received from data processing centres were no longer compatible with their analysis system, and that this was causing spuriously low conception rates. The data processing centres were asked to correct their data at that time. Accordingly, conception rates over time were graphed only from 2010 (Figure 8). This was done only for seasonal and split calving herds as conception rates were available for insufficient numbers of year-round calving herds. There was no evidence of systematic changes in conception rates over that period.

Table 11. Distributions of conception rates for seasonal and split calving herds (pooled) from 1997 to 2019

Year	No. mating periods included	Minimum	25th percentile	Median	75th percentile	Maximum
1997	0					
1998	0					
1999	0					
2000	23	15%	25%	38%	44%	55%
2001	30	5%	35%	47%	51%	71%
2002	54	1%	31%	38%	45%	65%
2003	46	1%	17%	30%	40%	58%
2004	52	1%	2%	26%	43%	62%
2005	68	1%	13%	29%	46%	72%
2006	80	1%	20%	36%	45%	68%
2007	79	1%	2%	25%	38%	59%
2008	111	1%	1%	21%	42%	87%
2009	97	1%	17%	34%	43%	59%
2010	136	5%	34%	42%	50%	100%
2011	133	3%	36%	43%	48%	71%
2012	139	21%	33%	40%	47%	67%
2013	278	7%	34%	40%	47%	71%
2014	298	3%	35%	41%	48%	100%
2015	298	2%	34%	41%	48%	74%
2016	258	13%	36%	42%	48%	94%
2017	235	11%	36%	42%	48%	69%
2018	181	16%	37%	43%	49%	100%
2019	127	13%	39%	43%	50%	74%

Table 12. Distributions of conception rates for year-round calving herds from 1997 to 2019

Year	No. mating periods included	Minimum	25th percentile	Median	75th percentile	Maximum
1997	0					
1998	0					
1999	0					
2000	1	19%	19%	19%	19%	19%
2001	0					
2002	2	22%	22%	23%	23%	23%
2003	3	24%	24%	32%	47%	47%
2004	3	1%	1%	44%	51%	51%
2005	7	2%	33%	40%	46%	65%
2006	3	3%	3%	38%	56%	56%
2007	10	3%	15%	34%	48%	84%
2008	10	1%	3%	7%	41%	48%
2009	8	1%	18%	25%	37%	42%
2010	12	28%	32%	37%	39%	57%
2011	7	22%	28%	34%	36%	41%
2012	14	22%	30%	36%	45%	58%
2013	55	1%	27%	33%	39%	51%
2014	72	14%	29%	36%	42%	59%
2015	76	17%	29%	35%	40%	52%
2016	61	14%	29%	33%	40%	56%
2017	40	19%	31%	34%	41%	51%
2018	23	25%	32%	38%	43%	100%
2019	13	24%	32%	38%	44%	51%

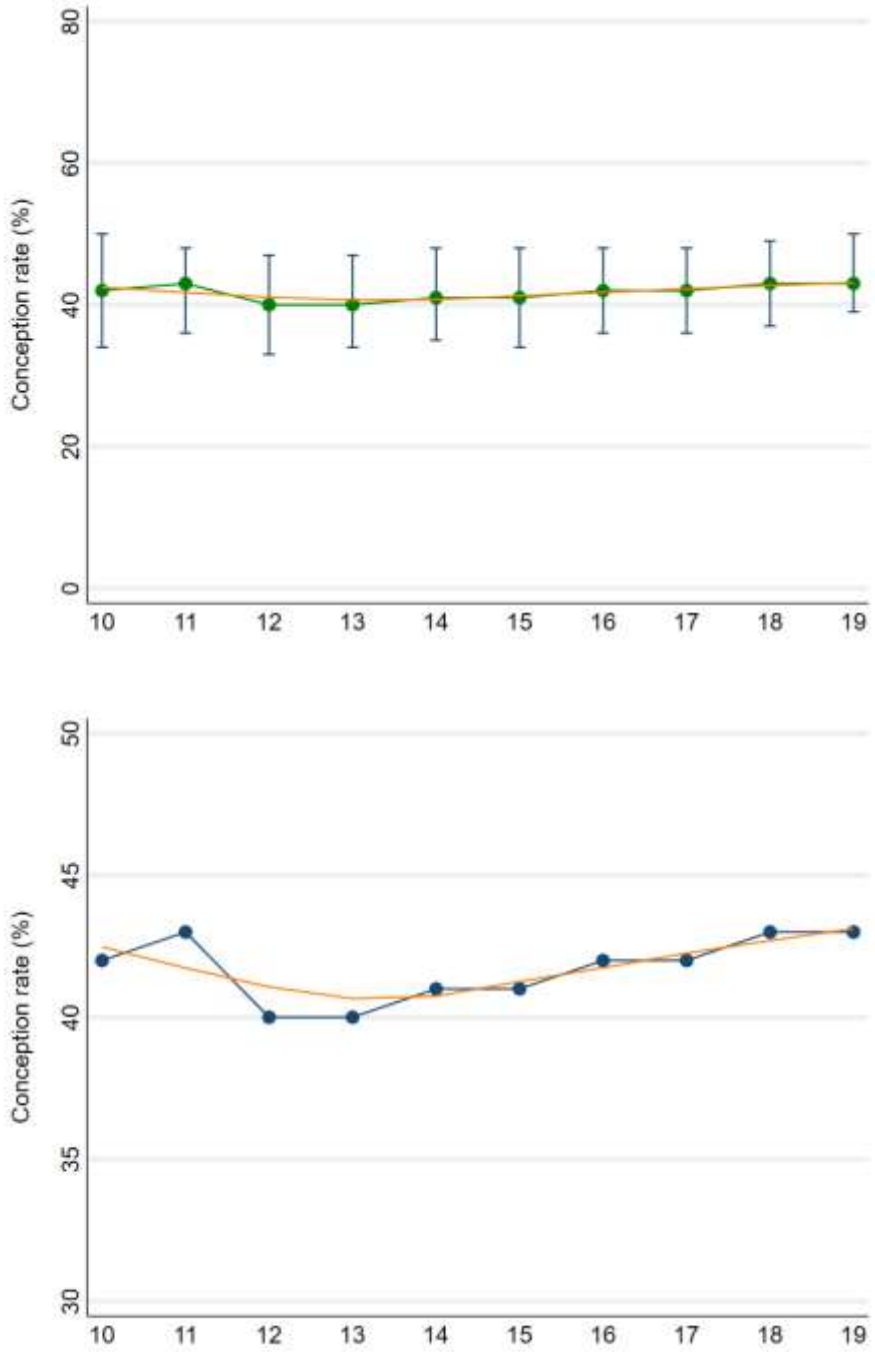

Figure 8. Median conception rates for seasonal and split calving herds from 1997 to 2019; both graphs are identical other than the reduced y-axis range in the lower graph and error bars in the upper graph indicating 25th and 75th percentiles within years; the orange line is the lowess (locally weighted regression) line of best fit through the medians.

REFERENCE

Morton JM (2011) InCalf Fertility Data Project 2011, Dairy Australia, Southbank, Australia

APPENDIX

NUMBERS OF HERDS BY REGION

Table A1. Distributions of numbers of mating periods analysed for seasonal and split calving herds by region and year

Year	Qld	NSW	Northern Vic	Gippsland	SW Vic	Tas	SA	WA	Total
1997	1	11	328	307	85	1			733
1998		16	293	298	103	7	1		718
1999	3	20	331	309	129		7		799
2000	4	17	232	261	135	7	7		663
2001	1	17	244	367	126	16	7		778
2002	2	15	218	354	110	15	7		721
2003	3	10	161	275	113	8	7		577
2004	3	12	146	202	134	1	6		504
2005	1	9	157	211	133		10		521
2006	4	10	125	205	132		4		480
2007	4	6	113	201	123		8		455
2008	2	5	112	212	129		7		467
2009	2	4	109	202	133		5		455
2010	2	7	88	208	142		4		451
2011	2	10	110	214	136	1	4		477
2012	1	8	121	218	115	10	4		477
2013		15	223	232	143	15	24	12	664
2014	1	22	219	235	144	15	26	13	675
2015	1	19	202	219	129	10	28	14	622
2016	1	23	190	219	119	8	35	15	610
2017	1	26	186	212	111	11	29	15	591
2018	2	21	130	188	103	7	15	11	477
2019		4	76	165	98	8	12	11	374
Pooled	41	307	4,114	5,514	2,825	140	257	91	13,289

Table A2. Distributions of numbers of 12-month periods analysed for year-round calving herds by region and year

Year	Qld	NSW	Northern Vic	Gippsland	SW Vic	Tas	SA	WA	Total
1997	2	43					1		46
1998	2	40		3	2		2		49
1999	39	36	1				3		79
2000	93	36	1	1	3		4		138
2001	79	27	5	2	2		9		124
2002	57	27	3	5	2		7		101
2003	49	25	4	3	3		5		89
2004	42	28	5	2	3		4		84
2005	42	23	11	7	8		6		97
2006	39	21	9	5	5		5		84
2007	36	15	10	4	7		3		75
2008	31	15	9	6	8		3		72
2009	32	12	9	3	8		5		69
2010	26	12	10	6	13		3		70
2011	28	9	13	11	7		4		72
2012	24	11	18	10	9		4		76
2013	27	55	32	10	9		17	8	158
2014	21	80	37	13	8		20	18	197
2015	22	70	43	15	11		21	14	196
2016	21	70	28	12	9		17	15	172
2017	21	62	25	13	6		17	14	158
2018	17	44	25	8	10		10	14	128
2019	11	24	10	6	3		3	9	66
Pooled	761	785	308	145	136	0	173	92	2,400