

35 years of St Kilda Little Penguin Research

1986 – 2020

Data collected by volunteers from Earthcare St Kilda

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A year-by-year summary of the St Kilda Penguin Colony using data collected on a (mostly) fortnightly basis by Earthcare St Kilda Volunteers. This summary was produced with thanks to funding from the Communities Environment Program provided by the Australian Government.

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Yearly Summaries



The following pages provide a basic summary of data collected for each year from 1986 – 2020. Earthcare St Kilda volunteers monitor the St Kilda breakwater (almost) every fortnight throughout the year. Volunteers attempt to catch every penguin that is seen to then scan/microchip, weigh and sex. The contents of each nest and the stage of moult was also recorded from 2002 onwards. During this time, we surveyed over 888 nights and microchipped/banded 5156 penguins. 1919 of these were chicks.

Up until 2019 the team monitored the entire breakwater. Due to the increased number of penguins, the team started monitoring just half of the breakwater in 2019. Occasionally data was not collected for every month of the year and information for this is provided within the summary. A renewal of the ethics permit in 2018 and COVID-19 in 2020 resulted in a reduction in the number of nights surveyed during these years.

Earthcare St Kilda are currently in the process of developing a new monitoring program with an aim to reduce the number of penguins requiring capture for accurate population monitoring.

1986 and 1987

On the 10th of June 1986, the Earthcare St Kilda research team surveyed the St Kilda breakwater for the very first time. The team surveyed over 12 nights and caught 116 penguins. 57 of these were unique penguins and all of them were banded upon capture. One penguin was caught 7 times and most penguins were caught only once (Table 1).

Table. 1 The number of penguins caught either seven, five, four, three two or once in 1986

Seven	Five	Four	Three	Two	One
1	5	6	4	7	34



The 1986-1987 breeding season

The first chick of the 1986-1987 breeding season was recorded on September 21, 1986 and the last chick recorded was on January 16, 1987. This breeding season lasted for ~four months. 16 chicks were banded and the average chick weight was $1317\text{g} \pm 220$. Note that the weight of chicks between 1986 – 2001 includes chicks of all ages (from those only a couple of weeks old to those about to fledge). This is because chick stage was not recorded until 2001. The average mass of adults during the 1986-1987 breeding season was $1265\text{g} \pm 196$.

During 1987, the team surveyed 31 nights across the whole year. They caught 296 penguins and 81 of these were unique penguins. 47 penguins were banded and the most number of times one penguin was caught was 10 (Table 2).

Table. 2 The number of penguins that were caught from 10-1 times in 1987

Ten	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
2	1	4	5	2	3	7	8	17	28

The 1987-1988 breeding season

The first chick of the 1987-1988 breeding season was recorded on November 8, 1987 and the last chick recorded was on February 28, 1988. This breeding season lasted for ~three months. 11 chicks were banded and the average chick weight was $1047\text{g} \pm 184$. The average mass of all adults during the 1987-1988 breeding season was $1168\text{g} \pm 207$.

1988 and 1989

In 1988, the team surveyed the breakwater on 34 nights and caught 269 penguins. 86 of these were unique penguins and 27 were banded. Three penguins were unlucky enough to be caught 13 times and one was caught ten times (Table 3).

The 1988-1989 breeding season

The first chick of the 1988-1989 breeding season was recorded on November 8, 1988 and the last chick recorded was on February 28, 1989. This breeding season lasted for ~four months. 13 chicks were banded and the average chick weight was $1177\text{g} \pm 128$. The average mass of adults during the 1988-1989 breeding season was $1266\text{g} \pm 231$.



Table. 3 The number of penguins caught either seven, five, four, three two or once in 1986

Thirteen	Ten	Eight	Seven	Six	Five	Four	Three	Two	One
3	1	3	2	4	4	6	12	10	40

During 1989, the team surveyed 33 nights across the whole year. They caught 234 penguins and 78 of these were unique penguins. Nine penguins were banded in total and for the first time, two penguins were caught 14 times (Table 4).

Table. 4 The number of penguins that were caught in 1989

Fourteen	Twelve	Ten	Nine	Seven	Five	Four	Three	Two	One
2	1	1	3	3	3	4	6	14	40

The 1989-1990 breeding season

The first chick of the 1989-1990 breeding season was recorded on December 3, 1989 and the last chick recorded was on March 11, 1990. This breeding season lasted for ~four months. Nine chicks were banded and the average chick weight was $1062\text{g} \pm 207$. Together with 1987, this was one of the lighter years for chick weights in the first 10 years of monitoring. The average mass of all adults during the 1987-1988 breeding season was $1156\text{g} \pm 250$.

1990 and 1991

The team surveyed the breakwater on 30 nights and caught 331 penguins. 107 of these were unique penguins and 22 were banded. The most times a penguin was caught was 11 times and the number of penguins caught once continues to get higher (Table 5).

The 1990-1991 breeding season

The first chick of the 1986-1987 breeding season was recorded on October 21, 1990 and the last chick recorded was on February 24, 1991. This breeding season lasted for ~five months. 22 chicks were banded and the average chick weight was $1159\text{g} \pm 242$. The average mass of adults during the 1990-1981 breeding season was $1184\text{g} \pm 178$.



Table. 5 The number of penguins caught either seven, five, four, three two or once in 1986

Eleven	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
1	2	3	4	4	5	8	13	19	47

During 1991, the team surveyed 29 nights across the whole year. They caught 384 penguins and 122 of these were unique penguins. 21 penguins were banded and five unlucky penguins were caught 10 times (one third of the survey nights) (Table 6). Some penguins are more susceptible to being caught due to their nest location or they may be less averse to being captured.

Table. 6 The number of penguins that were caught from 10-1 times in 1987

Ten	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
5	4	1	2	6	3	3	15	22	56

The 1991-1992 breeding season

The first chick of the 1987-1988 breeding season was recorded on August 25, 1991 and the last chick recorded was on February 23, 1992. This breeding season lasted for ~six months. Despite the long breeding season, 22 chicks were banded again during this breeding season. The average chick weight was similar to other eitherers at $1222\text{g} \pm 204$ and the average mass of all adults during the 1991-1992 breeding season was $1186\text{g} \pm 195$.

1992 and 1993

The team surveyed over 32 nights and caught 447 penguins. 147 of these were unique penguins and 37 were banded upon capture. Only penguin was caught 10 times this year and most penguins were caught only once (Table 7).

The 1992-1993 breeding season

The first chick of the 1992-1993 breeding season was recorded on November 1, 1992 and the last chick recorded was on March 7, 1993. This breeding season lasted for ~five months. 37 chicks were banded and the average chick weight was $1195\text{g} \pm 165$. The average mass of adults during the 1992-1993 breeding season was $1179\text{g} \pm 206$.



Table. 7 The number of penguins that were caught from 10-1 times in 1992

Ten	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
2	4	4	1	10	7	12	15	24	64

During 1993, the team surveyed 39 nights across the whole year. They caught 533 penguins and 199 of these were unique penguins. 44 penguins were banded and four penguins were caught 10 times (Table 8).

Table. 8 The number of penguins that were caught from 10-1 times in 1993

Ten	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
4	2	5	1	7	11	9	24	39	93

The 1993-1994 breeding season

The first chick of the 1993-1994 breeding season was recorded on September 19, 1993 and the last chick recorded was on March 6, 1994. This breeding season lasted for ~six months. This was a great year for breeding with lots of chicks banded and a very high average chick and adult mass. 54 chicks were banded and the average chick mass was $1881\text{g} \pm 192$. The average mass of all adults during the 1987-1988 breeding season was $1218\text{g} \pm 230$.

1994 and 1995

The team surveyed over 39 nights and caught 533 penguins. 227 of these were unique penguins and 47 were banded upon capture. One penguin was caught 12 times for the first time more than 100 penguins were caught once (Table 9).

The 1994-1995 breeding season

The first chick of the 1994-1995 breeding season was recorded on October 2, 1994 and the last chick recorded was on March 19, 1995. This breeding season lasted for ~five months. 41 chicks were banded and the average chick weight was $1118g \pm 224$. The average mass of adults during the 1994 - 1995 breeding season was $1193g \pm 221$.



Table. 9 The number of penguins that were caught between 12-1 times in 1994

Twelve	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
1	3	4	5	8	6	12	19	37	129

During 1995, the team surveyed 36 nights across the whole year. They caught 374 penguins and 192 of these were unique penguins. Only 22 penguins were banded and the greatest number of times one penguin was caught was 11 (Table 10).

Table. 10 The number of penguins that were caught from 11-1 times in 1987

Eleven	Eight	Seven	Six	Five	Four	Three	Two	One
1	2	2	3	7	7	20	42	108

The 1995-1996 breeding season

The first chick of the 1995-1996 breeding season was recorded on December 23, 1995 and the last chick recorded was on February 4, 1996. This breeding season lasted for ~three months. This was not a very productive breeding season with only 15 chicks banded and the average chick weight was the lowest ever recorded at $834g \pm 136$. The average mass of all adults during the 1995-1996 breeding season was also low at $1077g \pm 227$.

1996 and 1997

The team surveyed over 41 nights and caught 390 penguins. 149 of these were unique penguins and 29 were banded upon capture. The greatest number of times a penguin was caught was 10 times (Table 11).

The 1996-1997 breeding season

The first chick of the 1996-1997 breeding season was recorded on September 15, 1996 and the last chick recorded was on February 2, 1997. This breeding season lasted for ~five months. 26 chicks were banded and the average chick weight was $1199\text{g} \pm 174$. The average mass of adults during the 1996-1997 breeding season was $1214\text{g} \pm 202$.



Table. 11 The number of penguins that were caught from 10-1 times in 1996

Ten	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
	3	2	1	4	2	3	21	31	74

During 1997, the team surveyed 33 nights across the whole year. They only caught 284 penguins and 129 of these were unique penguins. Despite the lower capture rate, 46 penguins were banded and for the only year ever, one penguin was caught 17 times (Table 12). This suggests that a greater focus was made on breeding penguins this year.

Table. 12 The number of penguins that were caught from 17-1 times in 1997

Seventeen	Eleven	Ten	Seven	Six	Five	Four	Three	Two	One
1	1	2	1	2	2	10	17	23	70

The 1997-1998 breeding season

The first chick of the 1997-1998 breeding season was recorded on October 26, 1997 and the last chick recorded was on February, 1998. This breeding season lasted for ~five months. 27 chicks were banded and the average chick weight was $1067\text{g} \pm 267$. The average mass of all adults during the 1987-1988 breeding season was $1166\text{g} \pm 193$.

1998 and 1999

The team surveyed over 30 nights and caught 320 penguins. 141 of these were unique penguins and 53 were banded upon capture. The greatest number of times a penguin was caught was ten times (Table 13).

The 1998-1999 breeding season

The first chick of the 1998-1999 breeding season was recorded on October 25, 1998 and the last chick recorded was on February 28, 1999. This breeding season lasted for ~five months. Only 17 chicks were banded but the average chick mass was relatively normal at $1176\text{g} \pm 162$. The average mass of adults was $1175\text{g} \pm 182$.



Table. 13 The number of penguins that were caught 10-1 times in 1998

Ten	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
1	1	2	6	2	5	4	13	21	84

During 1999, the team surveyed 28 nights across the whole year. They caught 278 penguins and 154 of these were unique penguins. The number penguins banded doubled since 1993 with 82 penguins being banded. The greatest number of times one penguin was caught was 11 (Table 14).

Table. 14 The number of penguins that were caught from 11-1 times in 1999

Eleven	Ten	Nine	Seven	Six	Five	Four	Three	Two	One
1	1	1	1	2	3	8	10	25	102

The 1999-2000 breeding season

The first chick of the 1999-2000 breeding season was recorded on August 1, 1999 and the last chick recorded was on January 30, 2000. This breeding season lasted for ~six months. 34 chicks were banded and the average chick weight was $1132\text{g} \pm 253$. The average mass of all adults during the 1987-1988 breeding season was $1163\text{g} \pm 170$.

2000 and 2001

In 2000, the team surveyed over only 18 nights and caught 264 penguins. 151 of these were unique penguins and only 7 were banded upon capture. The greatest number of times a penguin was caught was just eight (Table 15).

The 2000-2001 breeding season

The first chick of the 2000-2001 breeding season was recorded on September 17, 2000 and the last chick recorded was on March 4, 2001. This breeding season lasted for ~ six months. 50 chicks were banded and the average chick weight was $1113\text{g} \pm 192$. The average mass of adults during the 2000-2001 breeding season was $1209\text{g} \pm 249$.



Table. 15 The number of penguins that were caught from 8-1 times in 2000

Eight	Seven	Six	Five	Four	Three	Two	One
1	1	1	5	8	12	27	96

During 2001, the team surveyed 20 nights across the whole year. They caught 300 penguins and 153 of these were unique penguins. On November 4, 2001, the team started microchipping instead of banding penguins. 18 penguins were banded and 11 were microchipped in 2001. The greatest number of times one penguin was caught was eight (Table 16).

Table. 16 The number of penguins that were caught from 8-1 times in 2001

Eight	Seven	Six	Five	Four	Three	Two	One
1	3	1	6	8	15	40	78

The 2001-2002 breeding season

The first chick of the 2001-2002 breeding season was recorded on November 18, 2001 and the last chick recorded was on January 20, 2002. This breeding season lasted for ~three months. 9 chicks were banded and 3 were microchipped. The average chick weight was $1216\text{g} \pm 127$. The average mass of all adults during the 2001-2002 breeding season was $1158\text{g} \pm 168$.

2002

In 2002, the Earthcare St Kilda research team surveyed the St Kilda breakwater on 23 nights. The team caught 240 penguins and 166 of these were unique penguins. Only one penguin was caught on 8 times and most penguins were caught only once (Table 17). Throughout the year we microchipped 130 penguins.

Table. 17 The number of penguins caught either eight, five, four, three two or once during the 2002

Eight	Five	Four	Three	Two	One
1	2	4	10	27	122



The 2002-2003 breeding season

The first eggs of the 2002-2003 breeding season were recorded on July 21, 2002 and the last chick recorded was on April 6 2003. This breeding season lasted for 9 months. Despite (or perhaps due to the long breeding period) this breeding season was not very productive. We only microchipped 10 chicks during this season and the average weight of all chicks was relatively low at $945\text{g} \pm 112$. The average weight of all breeding adults (i.e. all adults captured that were with chicks or eggs) was $1181\text{g} \pm 130$.

2003

The penguin research team surveyed on 20 nights in 2003 and caught 342 penguins. 257 of these were unique penguins. Throughout the year we microchipped 187 penguins and the greatest number of times that a penguin was caught was five times (Table 18).



Table 18. The number of penguins that were caught from 5-1 times in 2003

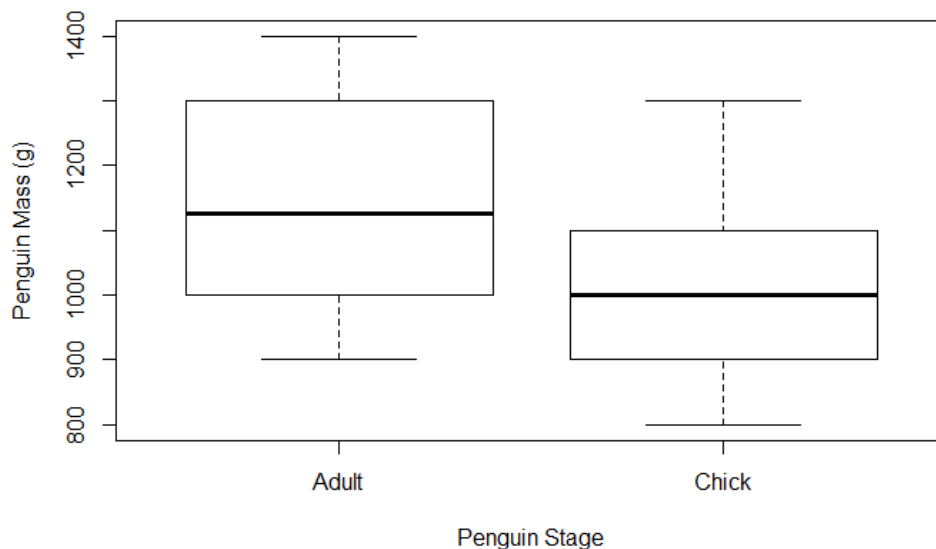
Five	Four	Three	Two	One
2	4	14	37	200

Moult

The first penguin was recorded moulting on November 3, 2002 and the last was recorded on April 6 2003 the same date that the previous breeding season (2002-2003) finished. We did not record enough moulting penguins to provide a summary on mass during moult in 2003.

The 2003-2004 Breeding season

The research team recorded the first eggs of the season on October 19, 2003 and the last chick was recorded on February 29, 2004. This breeding season lasted for ~five months. 19 chicks were microchipped and the mean mass of chicks was $1012\text{g} \pm 115$. For years 2003 – 2019, the mean mass of chicks is calculated just using chicks in the final stage of development before fledging. The average mass of all breeding adults (adults caught either with eggs or chicks) was $1146\text{g} \pm 162$. Adults were significantly heavier than chicks ($P = 0.014$).



2004

The penguin research team surveyed on 23 nights in 2004 and caught 546 penguins. 358 of these were unique penguins. Throughout the year we microchipped 289 penguins and the greatest number of times that a penguin was caught was seven times (Table 19).

Table 19. The number of penguins that were caught from 7-1 times in 2004

Seven	Six	Five	Four	Three	Two	One
1	2	1	12	25	82	235



Moult

The first penguin was recorded moulting on January 18, 2004 and the last was recorded on March 14, 2005. The average mass of penguins in the first stage of moult was $1566\text{g} \pm 217$ and the average mass of penguins in the final stage of moult was $1025\text{g} \pm 106$. During moult penguins are restricted to land for ~3 weeks. In order to cope with this fasting period, they put on a lot of weight before moult and then by the end of moult they are usually lighter than their usual mass. Pictured on this page is a moulting penguin in the first stage of moult.

The 2004-2005 Breeding season

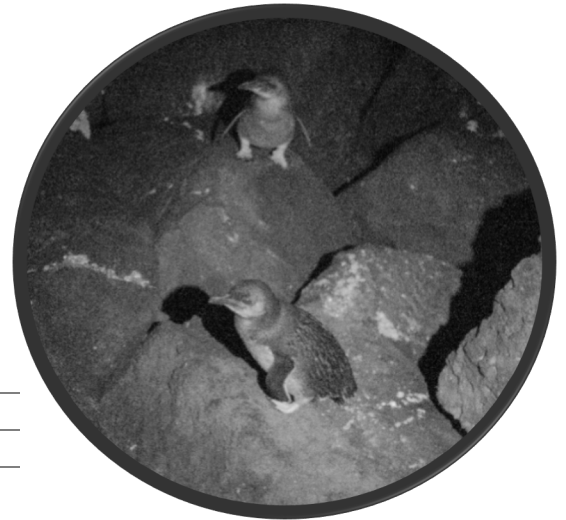
The research team recorded the first eggs of the season on November 21, 2004 and the last chick was recorded on February 20, 2005. This breeding season lasted for ~four months. 22 chicks were microchipped and average chick weight was very low at $940\text{g} \pm 270$. The average mass of all breeding adults was $1115\text{g} \pm 138$. Even though this was a very light year for chicks and adults were heavier, the difference was not significant.

2005

The penguin research team surveyed on 24 nights in 2005 and caught 841 penguins. 514 of these were unique penguins. Throughout the year we microchipped 296 penguins and the greatest number of times that a penguin was caught was ten (Table 20).

Table 20. The number of penguins that were caught from 10-1 times in 2005

Ten	Seven	Six	Five	Four	Three	Two	One
1	1	3	9	23	50	92	335



Moult

The first penguin was recorded moulting on December 5, 2004 (only one month after the previous breeding season started) and the last was recorded on April 17, 2005. We did not record enough moulting penguins to provide a summary on mass during moult in 2005.

The 2005-2006 Breeding season

The research team recorded the first eggs of the season on June 19, 2005 and the last chick was recorded on February 27, 2006. This breeding season lasted for ~eight months. 50 chicks were microchipped and average chick weight was $1128\text{g} \pm 221$. The average mass of all breeding adults was similar to 2004 at $1112\text{g} \pm 137$. On average, chicks were heavier than adults in this year but the difference was not significant.

2006

The penguin research team surveyed on 24 nights in 2006 and caught 808 penguins. 523 of these were unique penguins. Throughout the year we microchipped 211 penguins and the greatest number of times that a penguin was caught was seven times (Table 21).



Table 21. The number of penguins that were caught from 9-1 times in 2006

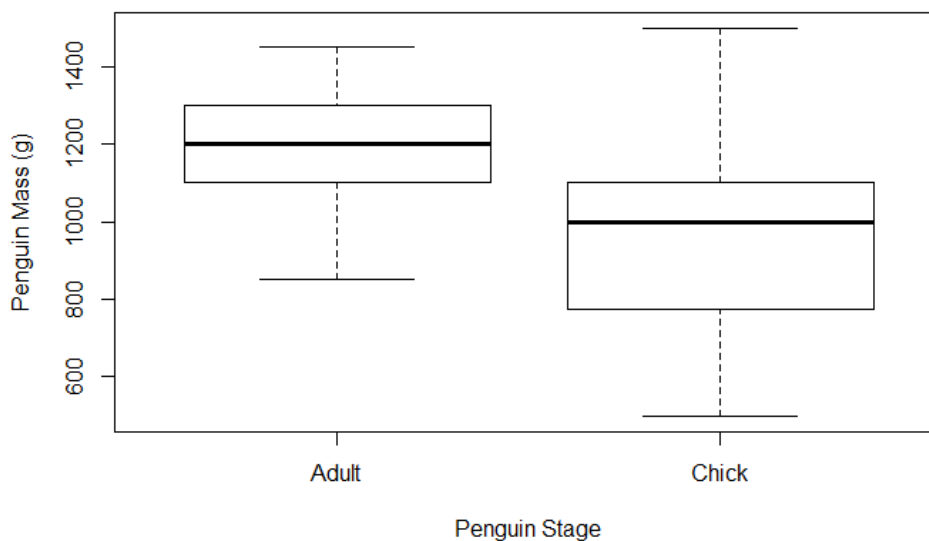
Nine	Seven	Six	Five	Four	Three	Two	One
1	1	4	10	25	45	99	338

Moult

The first penguin was recorded moulting on January 8, 2006, one fortnight before the last chick from the previous breeding season fledged (i.e there was a two-week overlap between breeding and moult). The last moulting penguin was recorded on March 26, 2006. The average mass of penguins in the first stage of moult was $1558\text{g} \pm 294$ and the average mass of penguins in the final stage of moult was $1000\text{g} \pm 105$.

The 2006-2007 Breeding season

The research team recorded the first eggs of the season on August 6, 2006 and the last chick was recorded on March 18, 2007. This breeding season lasted for ~seven months. 39 chicks were microchipped and average chick weight was low again at $969\text{g} \pm 237$. The average mass of all breeding adults was $1182\text{g} \pm 159$. During this breeding season, adults were significantly heavier than chicks ($P > 0.001$).



2007

The penguin research team surveyed on 24 nights in 2007 and caught 860 penguins. 523 of these were unique penguins. Throughout the year we microchipped 211 penguins and the greatest number of times that a penguin was caught was seven (Table 22).

Table 22. The number of penguins that were caught from 7-1 times in 2007

Seven	Six	Five	Four	Three	Two	One
3	3	10	25	45	99	338



Moult

The first penguin was recorded moulting on January 19, 2007 (two months before the end of the previous breeding season) and the last was recorded on May 6, 2007. The average mass of penguins in the first stage of moult was $1425\text{g} \pm 243$ and the average mass of penguins in the final stage of moult was $1027\text{g} \pm 159$.

The 2007-2008 Breeding season

The research team recorded the first eggs of the season on August 5, 2007 and the last chick was recorded on February 4, 2008. This breeding season lasted for ~five months. 38 chicks were microchipped and average chick weight was $1161\text{g} \pm 192$. The average mass of all breeding adults was similar to 2004 at $1100\text{g} \pm 117$. On average, chicks were heavier than adults in this year but the difference was not significant.

2008

The penguin research team surveyed on 24 nights in 2008 and caught 802 penguins. 475 of these were unique penguins. Throughout the year we only microchipped 146 penguins which is relatively low. The greatest number of times that a penguin was caught was eight and for the first time we caught more than 100 penguins twice (Table 23).

Table 23. The number of penguins that were caught from 10-1 times in 2008

Eight	Seven	Six	Five	Four	Three	Two	One
1	2	3	5	22	47	113	282



Moult

The first penguin was recorded moulting on February 4, 2008 which was the same day the previous breeding season finished (i.e. no overlap). The last moulting penguin was recorded on April 20, 2008. The average mass of penguins in the first stage of moult was $1503\text{g} \pm 258$ and the average mass of penguins in the final stage of moult was $1040\text{g} \pm 154$.

The 2008-2009 Breeding season

The research team recorded the first eggs of the season on May 8, 2008 and the last chick was recorded on Mar 1, 2009. This breeding season lasted for a whole ~ten months! Despite the length, only 31 chicks were microchipped and average chick weight was relatively normal at $1133\text{g} \pm 197$. The average mass of all breeding adults was $1164\text{g} \pm 113$. On average, adults were heavier than chicks but the difference was not significant.

2009

The penguin research team surveyed on 24 nights in 2009 and caught 956 penguins. 553 of these were unique penguins. Throughout the year we microchipped 252 penguins. The greatest number of times that a penguin was caught was nine and for the first time, six different penguins were caught eight times (Table 24).



Table 24. The number of penguins that were caught from 9-1 times in 2009

Nine	Eight	Seven	Six	Five	Four	Three	Two	One
3	6	1	5	11	18	48	112	349

Moult

The first penguin was recorded moulting on January 18, 2009 (two months before the previous breeding season finished) and the last was recorded on May 3, 2009. The average mass of penguins in the first stage of moult was $1419\text{g} \pm 199$ and the average mass of penguins in the final stage of moult was the lowest in 2009 at $944\text{g} \pm 94$.

The 2009-2010 Breeding season

The research team recorded the first eggs of the season on August 2, 2009 and the last chick was recorded on February 21, 2010. This breeding season lasted for ~five months. 77 chicks were microchipped which was a lot relative to previous years. The average chick mass was $1130\text{g} \pm 189$. The average mass of all breeding adults was $1136\text{g} \pm 142$. On average, adults were heavier than chicks but the difference was not significant.

2010

The penguin research team surveyed on 23 nights in 2010 and for the first time made over 1000 captures with 1041 penguins. 552 of these were unique penguins. Throughout the year we microchipped 234 penguins and the greatest number of times that a penguin was caught was ten (Table 25).



Table 25. The number of penguins that were caught from 10-1 times in 2010

Ten	Nine	Eight	Six	Five	Four	Three	Two	One
2	3	3	6	18	31	56	119	314

Moult

The first penguin was recorded moulting on January 3, 2010 (one month before the previous breeding season finished) and the last was recorded on March 21, 2010. The average mass of penguins in the first stage of moult was $1466\text{g} \pm 238$ and the average mass of penguins in the final stage of moult was $1064\text{g} \pm 195$.

The 2010-2011 Breeding season

The research team recorded the first eggs of the season on June 20, 2010 and the last chick was recorded on March 6, 2011. This breeding season lasted for ~nine months. 38 chicks were microchipped and the average chick mass was $1114\text{g} \pm 178$. The average mass of all breeding adults was $1128\text{g} \pm 161$. On average, adults were heavier than chicks but the difference was not significant.

2011

The penguin research team surveyed on 22 nights in 2011 and caught 1015 penguins. 631 of these were unique penguins. Throughout the year we microchipped 243 penguins and the greatest number of times that a penguin was caught was eleven (Table 26).



Table 26. The number of penguins that were caught from 11-1 times in 2011

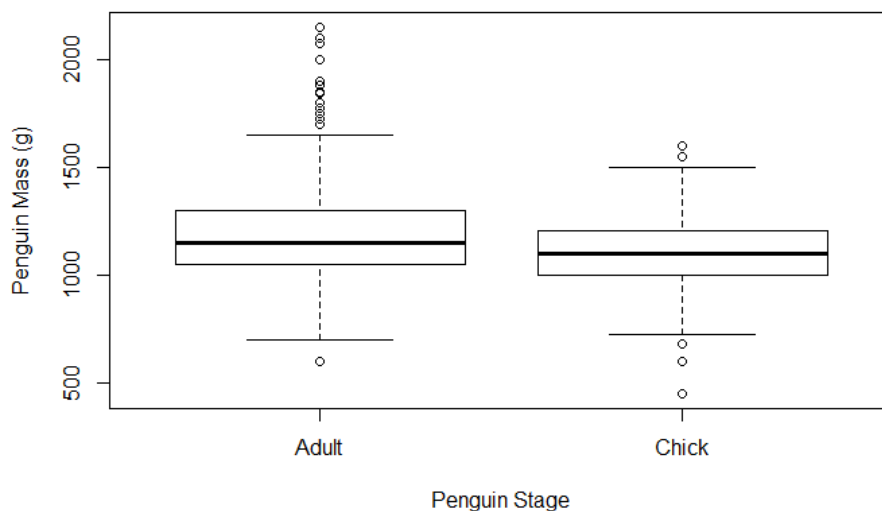
Eleven	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
1	1	1	4	8	10	26	47	112	392

Moult

The first penguin was recorded moulting on December 5, 2010 (three months before the end of the previous breeding season) and the last was recorded on April 4, 2011. The average mass of penguins in the first stage of moult was the lightest of all years at $1160\text{g} \pm 272$. Not enough penguins were caught in the final stage of moult to summarise the average mass.

The 2011-2012 Breeding season

The research team recorded the first eggs of the season on May 1, 2011 and the last chick was recorded on April 15, 2012. 126 chicks were microchipped and average chick weight was 1111 ± 201 . The average mass of all breeding adults was $1190\text{g} \pm 202$. On average, chicks were heavier than adults in this year but the difference was not significant. During this breeding season, adults were significantly heavier than chicks ($P > 0.001$).



2012

The penguin research team surveyed on 25 nights in 2012 and caught 1072 penguins. 658 of these were unique penguins. Throughout the year we microchipped 257 penguins and the greatest number of times that a penguin was caught was eight (Table 27).

Table 27. The number of penguins that were caught from 10-1 times in 2012

Eight	Seven	Six	Five	Four	Three	Two	One
2	4	6	8	24	49	145	419



Moult

The first penguin was recorded moulting on December 4, 2011 (four months before the previous breeding season finished) and the last was recorded on April 1, 2012. The average mass of penguins in the first stage of moult was $1194\text{g} \pm 220$ and the average mass of penguins in the final stage of moult was $1050\text{g} \pm 180$.

The 2012-2013 Breeding season

The research team recorded the first eggs of the season on August 12, 2012 and the last chick was recorded on February 1, 2013. This breeding season lasted for ~six months. 102 chicks were microchipped and the average chick mass was $1108\text{g} \pm 207$. The average mass of all breeding adults was $1146\text{g} \pm 165$. On average, adults were heavier than chicks but the difference was not significant.

2013

The penguin research team surveyed on 22 nights in 2013 and caught 1261 penguins. 709 of these were unique penguins. Throughout the year we microchipped 326 penguins and the greatest number of times that a penguin was caught was nine (Table 28).



Table 28. The number of penguins that were caught from 9-1 times in 2013

Nine	Eight	Seven	Six	Five	Four	Three	Two	One
1	3	9	7	18	24	59	172	416

Moult

The first penguin was recorded moulting on November 12, 2012 (four months before the previous breeding season finished) and the last was recorded on March 21, 2013. The average mass of penguins in the first stage of moult was $1451\text{g} \pm 234$ and the average mass of penguins in the final stage of moult was $1054\text{g} \pm 193$.

The 2013-2014 Breeding season

The research team recorded the first eggs of the season on July 21, 2013 and the last chick was recorded on February 22, 2014. This breeding season lasted for ~seven months. 108 chicks were microchipped and the average chick mass was $1078\text{g} \pm 215$. The average mass of all breeding adults was $1118\text{g} \pm 134$. On average, adults were heavier than chicks but the difference was not significant.

2014

The penguin research team surveyed on 22 nights in 2014 and caught 1593 penguins. 885 of these were unique penguins. Throughout the year we microchipped 459 penguins which is the greatest number microchipped in one year. The greatest number of times that a penguin was caught was eleven (Table 29).



Table 29. The number of penguins that were caught from 11-1 times in 2014

Eleven	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
1	1	3	4	11	19	43	72	181	540

Moult

The first penguin was recorded moulting on January 19, 2014 (one month before the previous breeding season finished) and the last was recorded on April 6, 2014. The average mass of penguins in the first stage of moult was $1515\text{g} \pm 242$ and the average mass of penguins in the final stage of moult was $1035\text{g} \pm 173$.

The 2014-2015 Breeding season

The research team recorded the first eggs of the season on July 20, 2014 and the last chick was recorded on February 15, 2015. This breeding season lasted for ~seven months. 147 chicks were microchipped and the average chick mass was $1202\text{g} \pm 245$. The average mass of all breeding adults was $1183\text{g} \pm 161$. On average, chicks were heavier than adults but the difference was not significant.

2015

The penguin research team surveyed on 23 nights in 2015 and caught 1929 penguins, the most penguins caught in a year. 1061 of these were unique penguins which is also the highest number of unique penguins caught. Throughout the year we microchipped 347 penguins and the greatest number of times that a penguin was caught was nine (Table 30).



Table 30. The number of penguins that were caught from 9-1 times in 2015

Nine	Eight	Seven	Six	Five	Four	Three	Two	One
1	4	10	15	3	44	93	247	614

Moult

The first penguin was recorded moulting on December 21, 2014 (three months before the previous breeding season finished) and the last was recorded on April 12, 2015. The average mass of penguins in the first stage of moult was $1432\text{g} \pm 295$ and the average mass of penguins in the final stage of moult was $1022\text{g} \pm 160$.

The 2015-2016 Breeding season

The research team recorded the first eggs of the season on July 5, 2015 and the last chick was recorded on February 21, 2016. This breeding season lasted for ~seven months. 207 chicks were microchipped which is the greatest number of chicks microchipped during one breeding season. The average chick mass was 1170 ± 204 . The average mass of all breeding adults was $1215\text{g} \pm 190$. On average, adults were heavier than chicks but the difference was not significant.

2016

The penguin research team surveyed on 25 nights in 2016 and caught 1773 penguins. 998 of these were unique penguins. Throughout the year we microchipped 293 penguins and the greatest number of times that a penguin was caught was eleven (Table 31).



Table 31. The number of penguins that were caught from 11-1 times in 2016

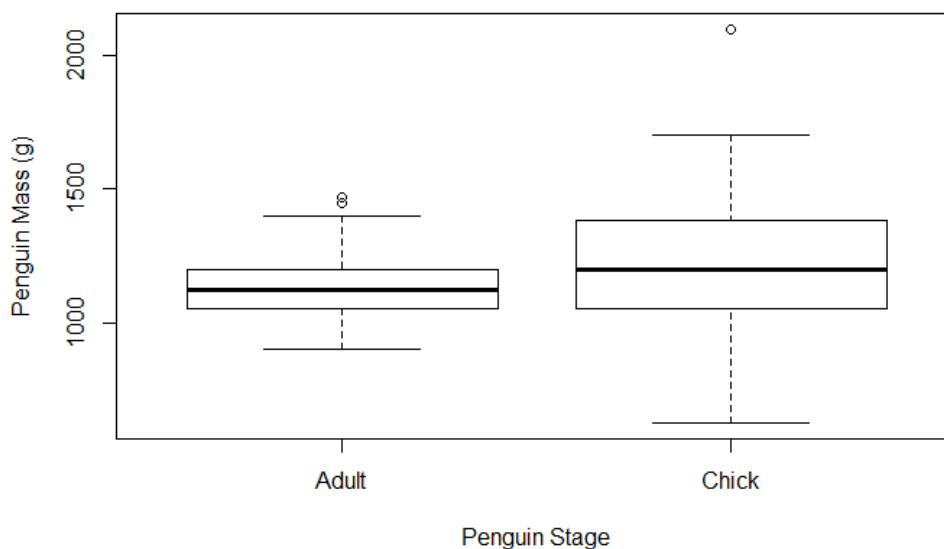
Eleven	Nine	Eight	Seven	Six	Five	Four	Three	Two	One
1	3	3	11	12	17	41	85	233	592

Moult

The first penguin was recorded moulting on December 20, 2015 (three months before the previous breeding season finished) and the last was recorded on April 3, 2016. The average mass of penguins in the first stage of moult was $1515\text{g} \pm 249$ and the average mass of penguins in the final stage of moult was $1003\text{g} \pm 134$.

The 2016-2017 Breeding season

The research team recorded the first eggs of the season on May 1, 2016 and the last chick was recorded on January 22, 2017. This breeding season lasted for ~eight months. 128 chicks were microchipped and the average chick mass was $1211\text{g} \pm 232$. The average mass of all breeding adults was $1133\text{g} \pm 132$. During this breeding season, chicks were significantly heavier than adults ($P > 0.014$).



2017

The penguin research team only surveyed on 17 nights in 2017 and caught 1245 penguins. 738 of these were unique penguins. The team did not collect data from January 2 to May 7. Throughout the year we microchipped 217 penguins and the greatest number of times that a penguin was caught was ten (Table 32).



Table 32. The number of penguins that were caught from 10-1 times in 2017

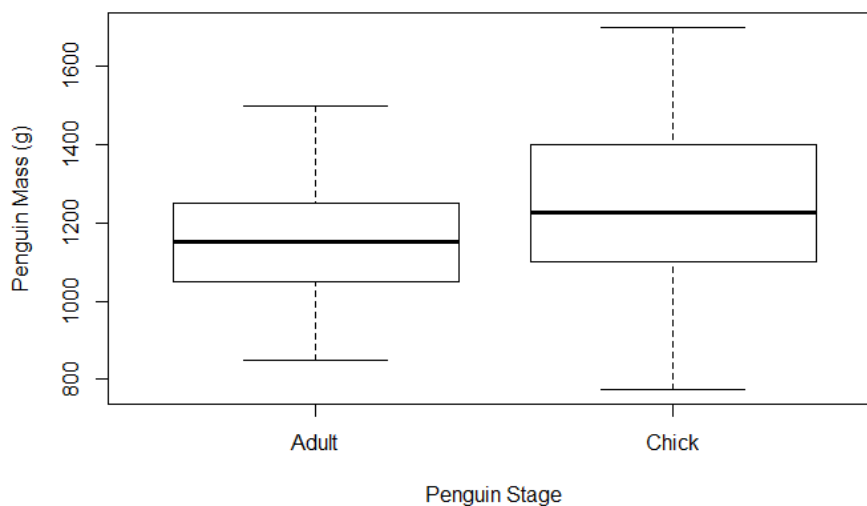
Ten	Eight	Six	Seven	Five	Four	Three	Two	One
1	1	1	7	15	30	69	163	450

Moult

The first penguin was recorded moulting on November 6, 2016 (three months before the previous breeding season finished) and the last was recorded on January 22, 2017. Note that this was the last date of surveys until May. The average mass of penguins in the first stage of moult was $1656\text{g} \pm 280$. We did not record enough data on penguins in the final stage of moult to present a summary here.

The 2017-2018 Breeding season

The research team recorded the first eggs of the season on August 16, 2017 and the last chick was recorded on February 4, 2018. This breeding season lasted for ~six months. 131 chicks were microchipped and the average chick mass was $1243\text{g} \pm 198$. The average mass of all breeding adults was $1155\text{g} \pm 153$. During this breeding season, chicks were significantly heavier than adults ($P > 0.003$).



2018

The penguin research team only surveyed on 13 nights in 201 and caught 861 penguins. 694 of these were unique penguins. The team did not collect data from March 13 to August 15. Throughout the year we microchipped 281 penguins and the greatest number of times that a penguin was caught was five (Table 33).



Table 33. The number of penguins that were caught from 3-1 times in 2018

Five	Four	Three	Two	One
1	2	21	116	553

Moult

The first penguin was recorded moulting on November 5, 2017 (four months before the previous breeding season finished) and the last was recorded on March 18, 2018. The average mass of penguins in the first stage of moult was $1549\text{g} \pm 158$ and the average mass of penguins in the final stage of moult was $1089\text{g} \pm 158$. These were the heaviest average weights for both first and final stages of moult.

The 2018-2019 Breeding season

The research team recorded the first eggs of the season on September 4, 2018 and the last chick was recorded on February 3, 2019. This breeding season lasted for ~five months. 149 chicks were microchipped and the average chick mass was $1107\text{g} \pm 208$. The average mass of all breeding adults was $1100\text{g} \pm 197$. On average, chicks were heavier than adults but the difference was not significant.

2019

The penguin research team surveyed on 22 nights in 2019 and caught 498 penguins. 348 of these were unique penguins. Throughout the year we microchipped 158 penguins and the greatest number of times that a penguin was caught was five (Table 34).

Table 34. The number of penguins that were caught from 5-1 times in 2019

Five	Four	Three	Two	One
5	8	21	52	260



Moult

The first penguin was recorded moulting on November 18, 2018 (three months before the previous breeding season finished) and the last was recorded on April 28, 2019. The average mass of penguins in the first stage of moult was $1328\text{g} \pm 246$ and the average mass of penguins in the final stage of moult was $960\text{g} \pm 178$.

The 2019-2020 Breeding season

The research team recorded the first eggs of the season on May 12, 2019 and the last chick was recorded on February 16, 2020. This breeding season lasted for ~nine months. 91 chicks were microchipped and the average chick mass was $1213\text{g} \pm 200$. The average mass of all breeding adults was $1180\text{g} \pm 180$. On average, chicks were heavier than adults but the difference was not significant.

2020

The penguin research team surveyed on 3 nights in 2020 before they were not able to access the breakwater due to COVID-19. They caught 123 penguins and 111 of these were unique penguins. They microchipped 38 penguins and the greatest number of times that a penguin was caught was three (Table 35).

Table 35. The number of penguins that were caught from 3-1 times in 2020

Three	Two	One
2	9	99

Dataset Summaries



The number of penguins caught each year saw a peak around 2004 followed by a steady increase from 2002-2018 (figure 1). This increase is likely a result of an increase in capture effort as well as an increase in the population size of the colony. The number of chicks microchipped each year (figure 2) supports the theory of an increasing population as capture effort remained relatively consistent from 2002-2017 and the number of chicks microchipped increased during this period.

The average mass of breeding adults and chicks has remained relatively constant throughout the years with a big increase in the mass of chicks in 1993 and a decrease in the mass of both chicks and adults in 1996 (figure 3). In some years chicks are heavier than adults and in other years adults are heavier than chicks. The only years with significant differences are 2003, 2006 and 2011 where adults were significantly heavier than chicks and 2016 and 2017 where chicks were significantly heavier than adults. The duration of breeding varies a lot from 3-10 months between years (figure 4). There is a clear increase in duration of breeding from 2002 onwards. This is due to the methods of summation because after 2002 the start of breeding was determined by the presence of eggs and prior to 2002 the start of breeding was determined by the first chick of the season.

The duration of moult appears to fluctuate throughout the years but with a more steady pattern of peaks and troughs (figure 4). As expected, the average mass of adults in the first stage of moult is higher than the average mass of adults in the final stage of moult. There appears to be more fluctuation in the mass of adults in the first stage of moult than those in the final stage of moult.

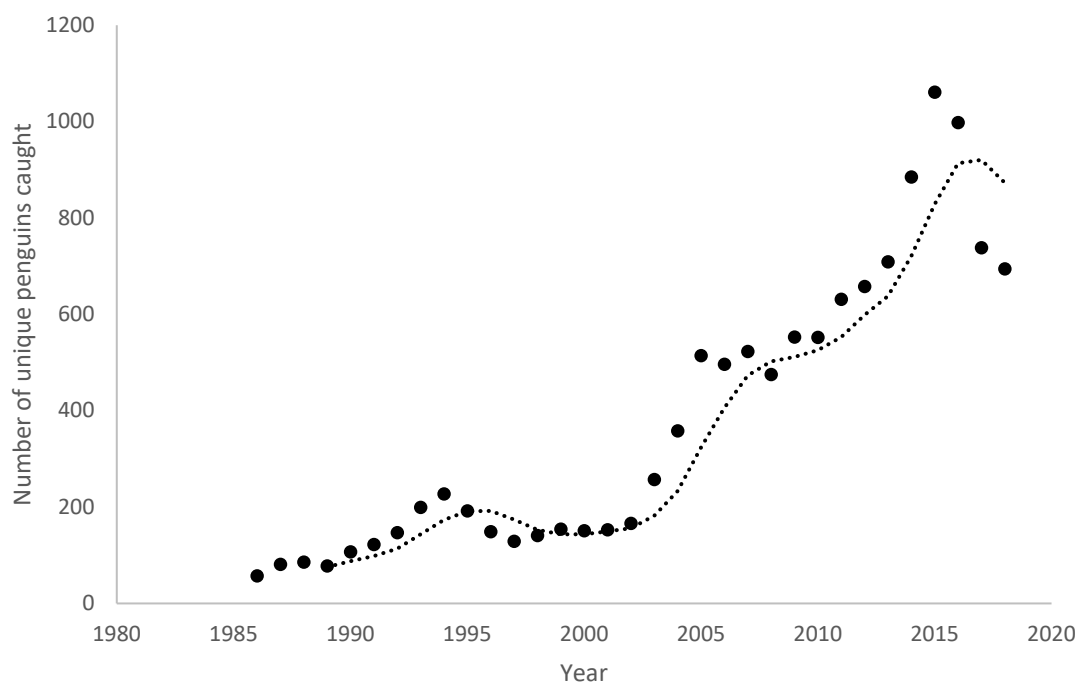


Figure 1. The number of unique penguins caught each year from 1986 – 2019. The trenline shows a moving average over a period of four years.

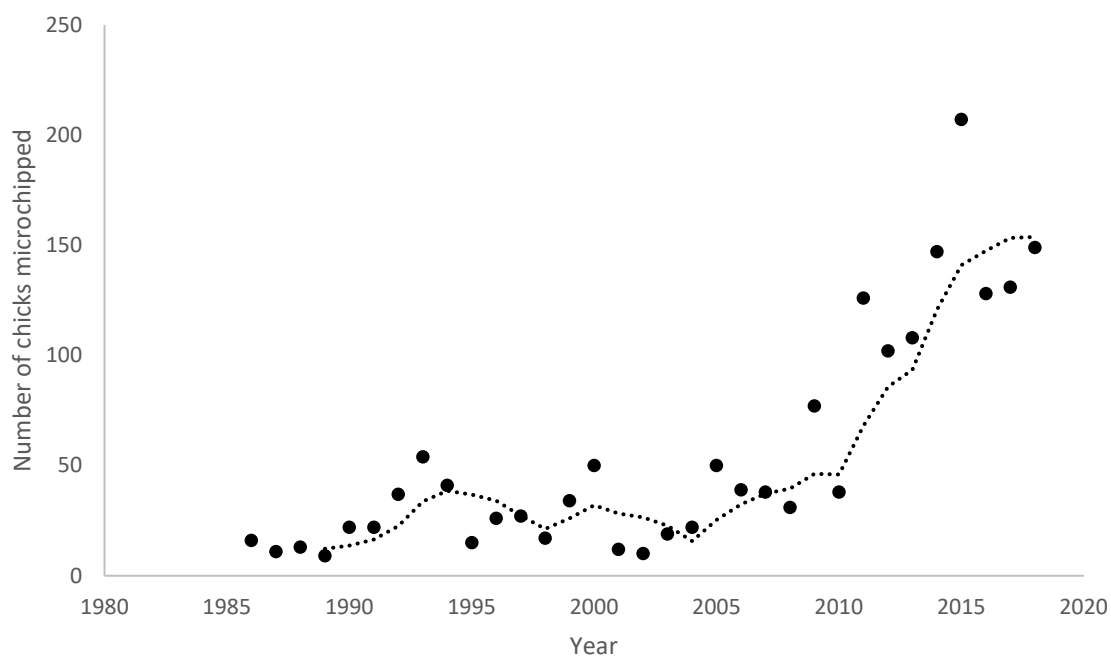


Figure 2 The number of chicks microchipped each year from 1986 – 2019. The trenline shows a moving average over a period of four years.

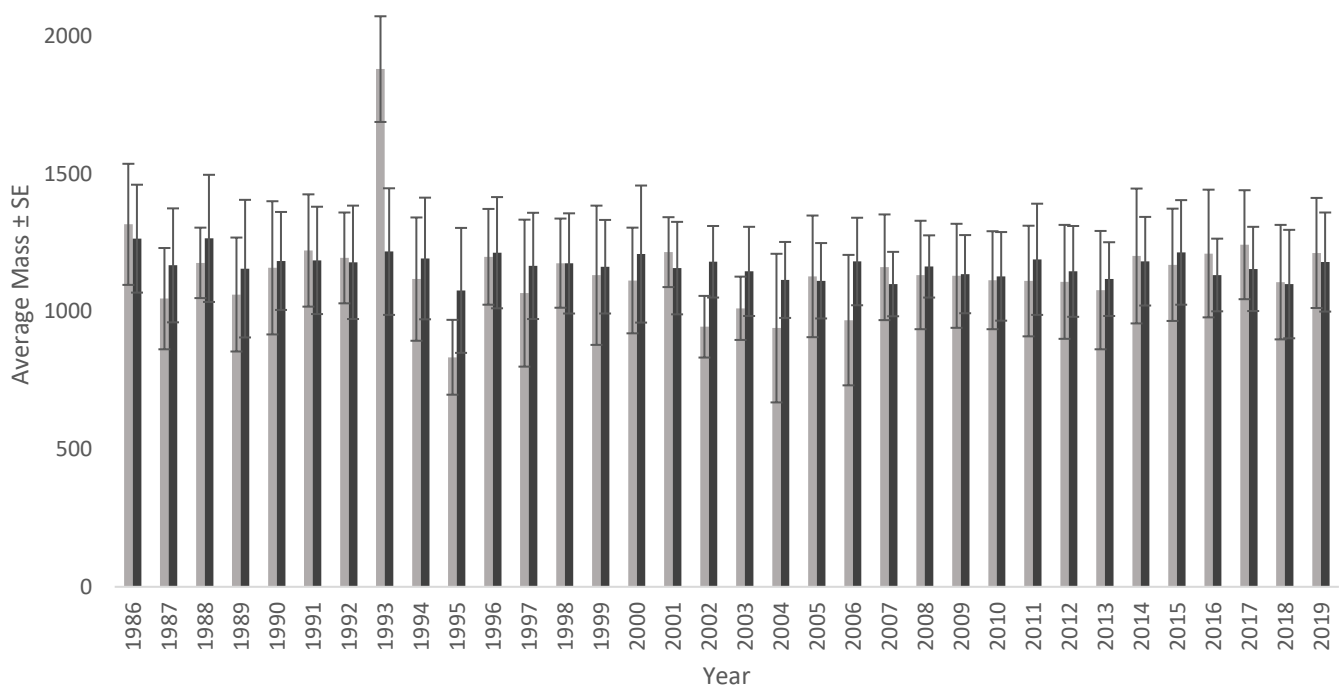


Figure 3 The average mass \pm SE of adults (black bars) and chicks (grey bars) each breeding season from 1986 – 2019. The breeding season is denoted by the year eggs were first discovered (i.e. 1986 represents the 1986-1987 breeding season).

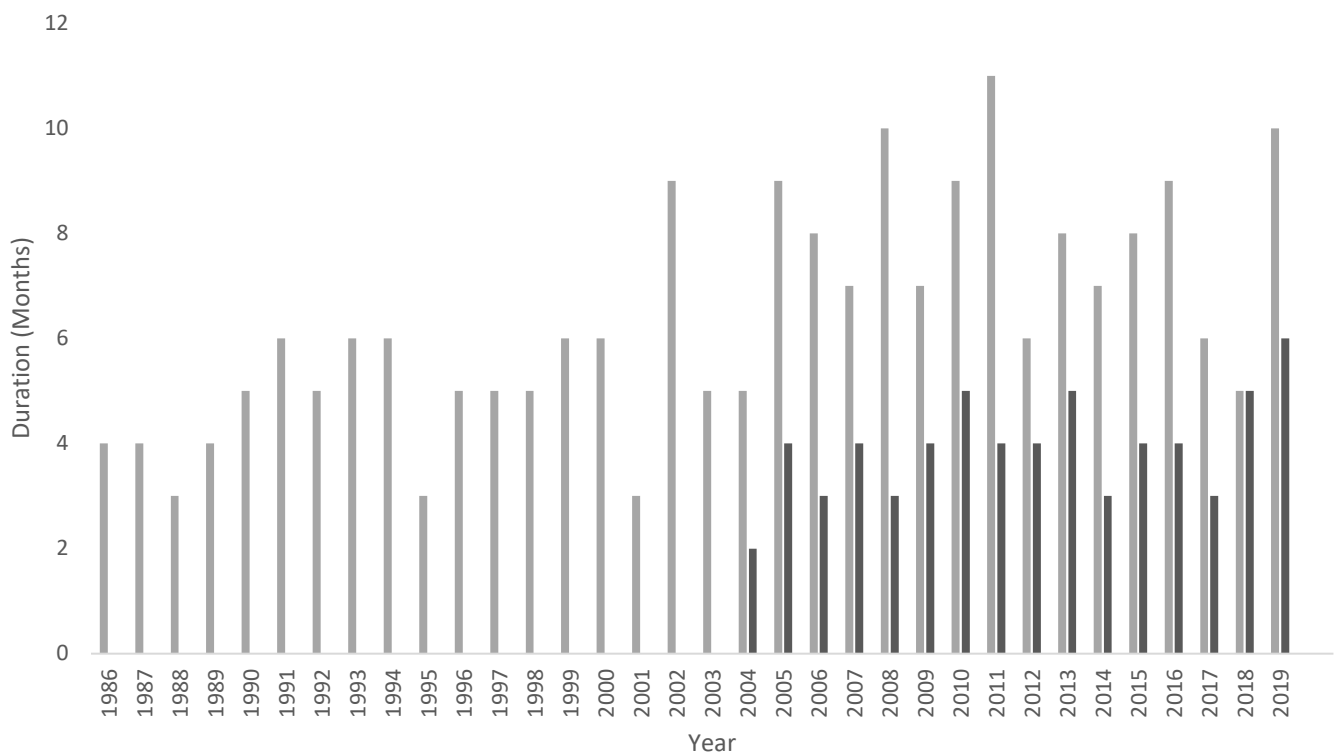


Figure 4 The duration in months of breeding (grey bars) from 1986 – 2019 and moult (black bars) from 2004 – 2019.

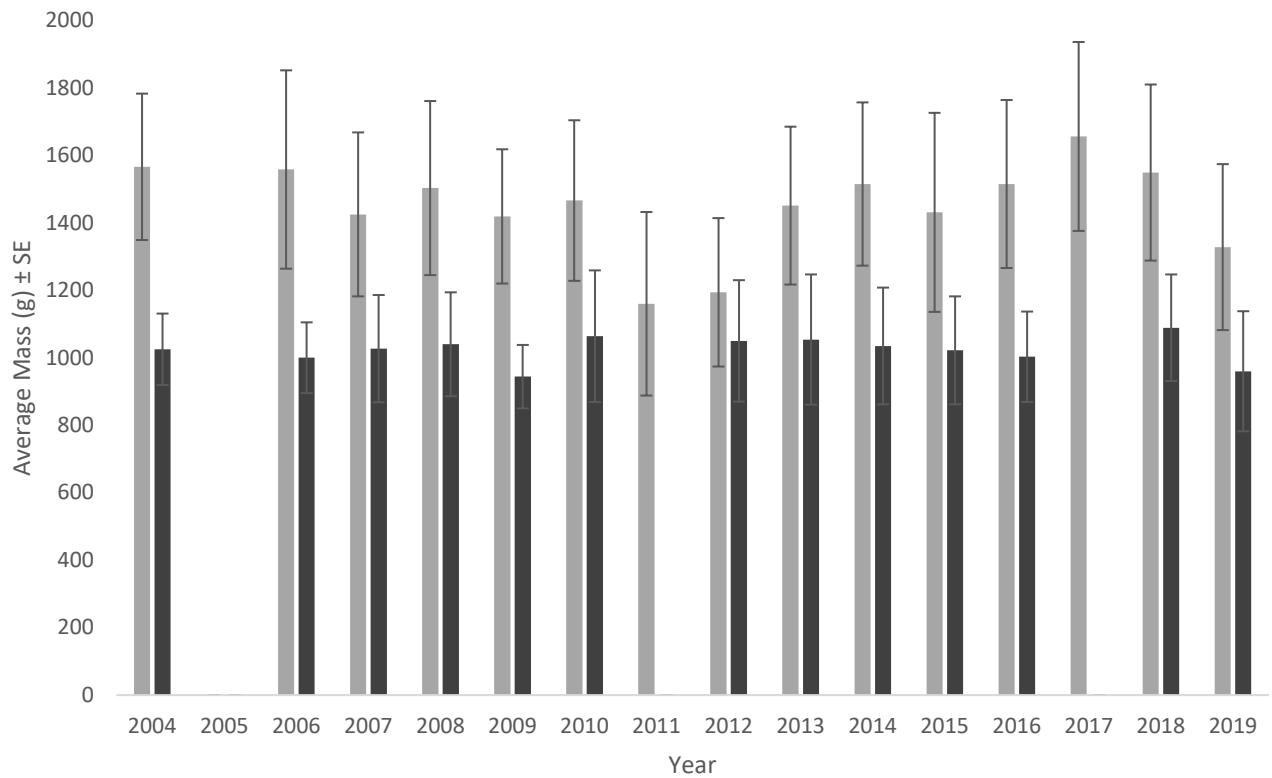


Figure 5 The average mass \pm SE of stage 1 moult (grey bars) and final moult stage (black bars) for each moult season from 2004-2019. No data was available for 2005 and for the final stage of moult in 2001 and 2017.

Supplementary Material

Table 1. The number of nights surveyed, total and unique penguins caught and number of adults and chicks microchipped each year from 1986-2020.

Year	Nights surveyed	Total Penguins caught	Unique penguins caught	Number of adults microchipped	Number of chicks microchipped
1986	12	116	57	55	16
1987	31	293	81	47	11
1988	34	269	86	27	13
1989	33	234	78	9	9
1990	30	331	107	22	22
1991	29	384	122	21	22
1992	32	447	147	37	37
1993	39	533	199	44	54
1994	39	533	227	47	41
1995	36	374	192	22	15
1996	41	390	149	29	26
1997	33	284	129	46	27
1998	30	320	141	53	17
1999	28	278	154	82	34
2000	18	264	151	7	50
2001	20	300	153	29	12
2002	23	240	166	130	10
2003	20	342	257	187	19
2004	23	546	358	289	22
2005	24	841	514	296	50
2006	24	808	496	215	39
2007	24	860	523	211	38
2008	24	802	475	146	31
2009	24	956	553	252	77
2010	23	1041	552	234	38
2011	22	1015	631	243	126
2012	25	1072	658	257	102
2013	22	1261	709	326	108
2014	22	1593	885	459	147
2015	23	1929	1061	347	207
2016	25	1773	998	293	128
2017	17	1245	738	217	131
2018	13	861	694	281	149
2019	22	498	348	158	91
2020	3	123	111	38	NA

Table 2. The start and end date of each breeding season as well as the duration in months and the average chick and adult mass with standard deviations and P-value for the difference between adult and chick mass.

Year	Breeding season start date	End date	Duration (months)	Average chick mass	Chick mass SD	Average adult mass	Adult mass SD	P-value
1986	21/9/86	16/1/87	4	1317	220	1265	196	NA
1987	8/11/87	28/2/88	4	1047	184	1168	207	NA
1988	4/12/88	26/2/89	3	1177	128	1266	231	NA
1989	3/12/89	11/3/90	4	1062	207	1156	250	NA
1990	21/10/90	24/2/91	5	1159	242	1184	178	NA
1991	25/8/91	23/2/92	6	1222	204	1186	195	NA
1992	1/11/92	7/3/93	5	1195	165	1179	206	NA
1993	19/9/93	6/3/94	6	1881	192	1218	230	NA
1994	2/10/94	19/3/95	6	1118	224	1193	221	NA
1995	23/12/95	4/2/96	3	834	136	1077	227	NA
1996	15/9/96	2/2/97	5	1199	174	1214	202	NA
1997	26/10/97	1/3/98	5	1067	267	1166	193	NA
1998	25/10/98	28/2/99	5	1176	162	1175	182	NA
1999	1/8/99	30/1/00	6	1132	253	1163	170	NA
2000	17/9/00	4/3/01	6	1113	192	1209	249	NA
2001	18/11/01	20/1/02	3	1216	127	1158	168	NA
2002	21/7/02	6/4/03	9	945	112	1181	130	NA
2003	19/10/03	29/2/04	5	1012	115	1146	162	0.014
2004	21/11/04	20/2/05	5	940	270	1115	138	0.227
2005	19/6/05	27/2/06	9	1128	221	1112	137	0.6699
2006	6/8/06	18/3/07	8	969	237	1182	159	<0.001
2007	5/8/07	4/2/08	7	1161	192	1100	117	0.14
2008	4/5/08	1/3/09	10	1133	197	1164	113	0.46
2009	2/8/09	21/2/10	7	1130	189	1136	142	0.86
2010	20/6/10	6/3/11	9	1114	178	1128	161	0.68
2011	1/5/11	15/4/12	11	1111	201	1190	202	<0.001
2012	12/8/12	1/2/13	6	1108	207	1146	165	0.12
2013	21/7/13	22/2/14	8	1078	215	1118	134	0.17
2014	20/7/14	15/2/15	7	1202	245	1183	161	0.54
2015	5/7/15	21/2/16	8	1170	204	1215	190	0.094
2016	1/5/16	22/1/17	9	1211	232	1133	132	0.014
2017	14/8/16	4/2/18	6	1243	198	1155	153	0.003
2018	4/9/18	3/2/19	5	1107	208	1100	197	0.84
2019	12/5/19	16/2/20	10	1213	200	1180	180	0.27

Table 3. The start and end dates of each moult season from 2003-2018 as well as the duration in months and average mass during the first and last stages of moult.

Year	Month Moult started	Month moult finished	Duration (Months)	Stage 1 mass	Stage 1 SD	Final stage mass	Final stage SD
2003	18/1/04	14/3/04	2	1566	217	1025	106
2004	5/12/04	17/4/05	4	NA	NA	NA	NA
2005	8/1/06	26/3/06	3	1558	294	1000	105
2006	19/1/07	6/5/07	4	1425	243	1027	159
2007	4/2/08	20/4/08	3	1503	258	1040	154
2008	18/1/09	3/5/09	4	1419	199	944	94
2009	3/1/10	21/3/10	5	1466	238	1064	195
2010	5/12/10	4/4/11	4	1160	272	NA	NA
2011	4/12/11	1/4/12	4	1194	220	1050	180
2012	18/11/12	21/3/13	5	1451	234	1054	193
2013	19/1/13	6/4/14	3	1515	242	1035	173
2014	21/12/14	12/4/15	4	1431	295	1022	160
2015	20/12/15	3/4/16	4	1515	249	1003	134
2016	6/11/16	22/1/17	3	1656	280	NA	NA
2017	5/11/17	18/3/18	5	1549	261	1089	158
2018	18/11/18	28/4/19	6	1328	246	960	178