INTER-ANNUAL VARIATION IN GROWTH RATES OF CASSIN'S AUKLET CHICKS ON EAST LIMESTONE ISLAND, HAIDA GWAII

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SUMMARY

Data of Cassin's Auklet chicks collected during the 2016 breeding season and retrieved archived data of Cassin's Auklet chick wing and weight measurements of previous years (2005, 2013-2015) was used to calculate growth rates. These growth rates, as well as chick mass at 25 days old, were compared with Cassin's Auklet mass at 25 days old at Triangle Island to look for inter-annual synchronicity. Synchronicity between populations hints at a larger common factor influencing these geographically separate colonies, such as oceanic oscillations. Every breeding season, Cassin's Auklet chicks are measured approximately every 5 days on East Limestone Island, Haida Gwaii. The Laskeek Bay Conservancy has been monitoring Cassin's Auklet chicks from the artificial nest boxes they installed in the early 1990s.

Keywords: East Limestone Island, Cassin's Auklet, growth rates, synchronicity, oceanic oscillations

Introduction

The Cassin’s Auklet is a seabird species of the family Alcidae, found in colonies throughout the Baja California to southwestern Alaska. Cassin’s Auklet spend their lives at sea, feeding on a diet including copepods, euphausiids and larval fish (COSEWIC). They come to land in the late spring/early summer to breed in burrows. About 80% of the global population resides in British Columbia (Laskeek Bay Conservation Society).

There is a small population of Cassin’s Auklet on East Limestone Island (ELI). They are one population of Cassin’s Auklet that feed and live along the Alaska Current System (COSEWIC). Natural burrows are found throughout the island, and in the early 1990s Laskeek Bay Conservation Society (LBCS) installed preliminary artificial nest boxes in one location as protection against raccoons. Most nesting boxes that are currently monitored were installed between 2006 and 2007.

Wing chord and weight measurements from 2005 and 2013-2016 have been used to calculate growth rates. These growth rates are organized into tables and graphs to compare inter-annual variation (see Table 2). The hatch dates for each chick are estimated using a standardized table developed at Triangle Island that assigns wing chord length to age. Hatch dates can give an idea on whether the breeding season is early or late in relation to other years.

The calculated growth rates are compared to those at Triangle Island to look for similarities in patterns. If growth rates are fluctuating synchronously, larger oceanic oscillations may be responsible for the similar effects on these separated populations. The oscillations affect the growth rate of Cassin's Auklet chicks by changing prey availability (ie. Warmer temperatures lowering ocean productivity) (Bertram, et al.).

Study Area and Methods

Cassin's Auklet chicks are monitored on East Limestone Island (ELI). East Limestone Island is a small island in Laskeek Bay on the archipelago of Haida Gwaii (Fig. 1). During the breeding season, ELI is resident to many species of seabirds including Ancient Murrelets, Cassin's Auklet, Black Oystercatchers, Pigeon Guillemots and more (Laskeek Bay Conservation Society).

The artificial nestboxes used on ELI are constructed wooden boxes with a tunnel leading from an entrance hole to the back of the box. These boxes are inspected in early May for usability. Also in early May, "knockdown" sticks are set up at the entrance of the burrow to identify whether birds are coming in and out of the boxes. Throughout May the knocked down sticks are recorded and set up again. After May 22, nest boxes that had frequent knocked down sticks are checked for occupancy by opening them up. Boxes that are occupied by a chick are checked approximately every 5 days throughout the rest of the season, but sometimes boxes are checked earlier or later if it is raining, or if biologists are busy off island with other projects. Weight is measured by placing a chick into a small bag and then using a spring scale of either 50 g, 100 g, or 300 g. Also, wing chord is measured by placing an unflattened wing on a wing ruler (Laskeek Bay Conservation Society).

Growth rates for 2005, 2013, 2014, 2015 and 2016 were calculated using changes in wing cord over time (mm/day), and changes in weight over time (g/day) (see Table 2).

For years where more than one chick was measured, growth rates were averaged to give an estimate for that particular year. The growth rate for all years was averaged and yearly anomalies calculated to see how much they fluctuated from the overall average (Table 3).

Yearly growth rate anomalies were compared with those of the Triangle Island population to analyze for synchronicity in patterns. This is thus used to support or refute the hypothesis of larger oceanic oscillations influencing growth rates of geographically disparate populations.

To calculate hatch dates, chick ages were first calculated using a standardized table developed at Triangle Island which assigns chick ages according to a range in wing length (Table 1). This table is used to determine the age of the chick the first day it was measured, from which the hatch date can be determined. Ages and hatch dates were calculated from the first date of measurement to be as accurate as possible, but they are still only estimates as chicks were not visited on the day of hatching.

Age:	wc (mm):	Age:	wc (mm):	Age:	wc (mm):	Age:	wc (mm):	Age:	wc (mm):
0	<15-15.8	**5**	19.4-20.6	**10**	25.4-26.6	**15**	39.4-42.6	**20**	55.4-58.6
1	15.8-16.7	**6**	20.6-21.8	**11**	26.6-29.8	**16**	42.6-45.8	**21**	58.6-61.8
2	16.7-17.6	**7**	21.8-23.0	**12**	29.8-33.0	**17**	45.8-49.0	**22**	61.8-65.0
3	17.6-18.5	**8**	23.0-24.2	**13**	33.0-36.2	**18**	49.0-52.2	**23**	65.0-68.2
4	18.5-19.4	**9**	24.2-25.4	**14**	36.2-39.4	**19**	52.2-55.4	**24**	68.2-71.4
								25	71.4-82.0

Table 1 Table showing age (days) according to wing chord length (mm). Credit to Mark Hipfner.

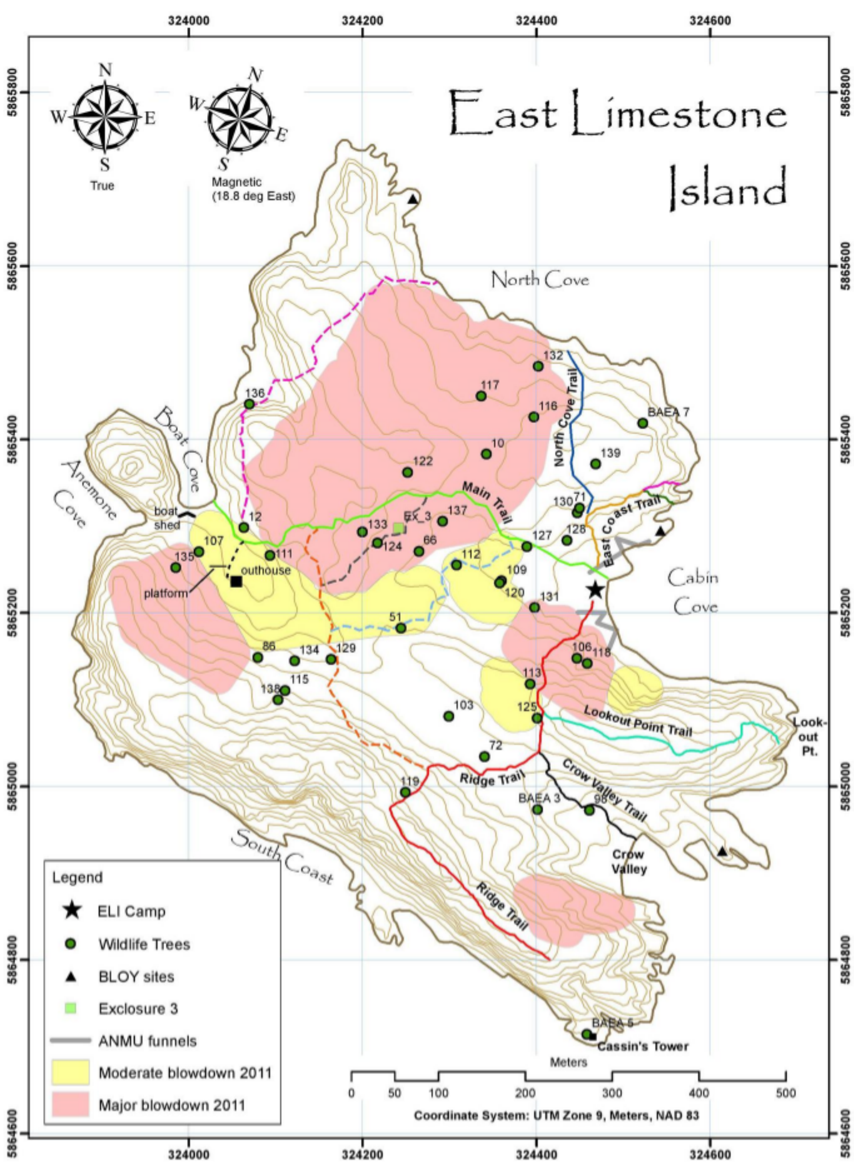

Fig. 1 Map showing relative size of East Limestone Island, with trails and blowdown areas marked. Also marked are nesting sites (including nesting trees) to date.

Results

Tables were made of each chick which listed the various measurements (wing chord and weight) as well as age and hatch date (see Table 2). From this, graphs were made showing the growth rate according to both wing chord and mass for each chick. An example of chick NB3 (identified by nest box number) from 2005 is shown below (Fig. 2, and Fig. 3).

Chick #	Date	Contents	B + B (g)	Bag Wt (g).	BirdWt (g)	Days (between measurement)	Wing Cord (mm)	Age (days)	Hatch date
NB3	20-May	1 chick	68	11	57	0			
NB3	24-May	1 chick	105	20	85	4	35	18	6-May
NB3	29-May	1 chick	126	23.5	102.5	9	48	23	
NB3	4-Jun	1 chick	138	22	116	15	55	29	
NB3	7-Jun	1 chick	162	31	131	18	68	32	
NB3	17-Jun	1 chick	194	38	156	28	107		
NB3	22-Jun	1 chick	182	24	158	33	112		
NB3	29-Jun	FLEDGED				40			

Table 2 An example of a data table of one chick (NB3 from 2005) listing dates of measurement and corresponding weights and wing chord, as well as age and hatch date.

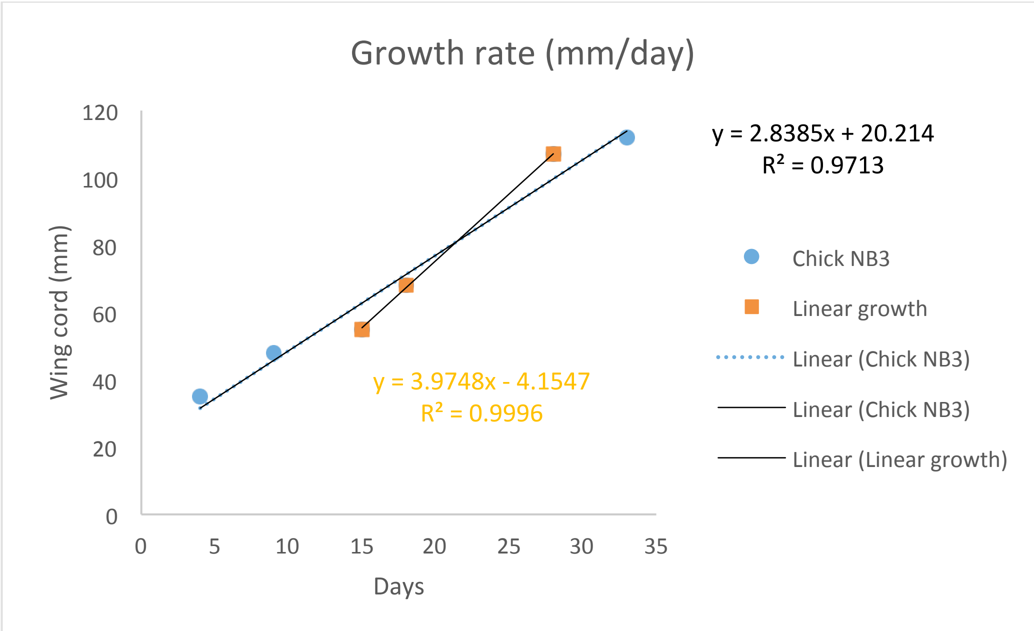

Fig. 2 Calculated growth rates of wing chord (mm/day) fitted with a line of best fit.

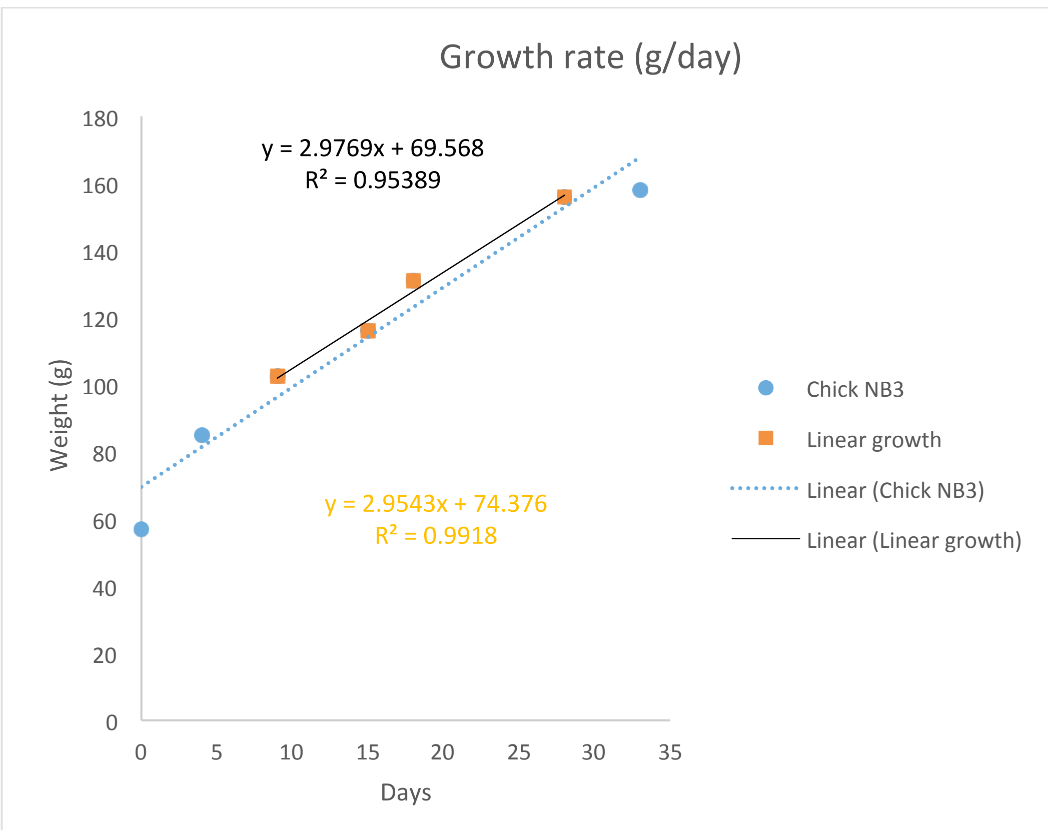

Fig. 3 Calculated growth rates of weight (g/day) fitted with a line of best fit.

Another line of best fit was fitted to the points that corresponded as closely as possible to the 10-25 day range (indicated by the orange data points) in which the chick was measured. This period has the most linear growth rate (Morbey, et al.). Although it would have been ideal to fit the linear growth rate corresponding to chicks at 10-25 days of age, the calculated ages were only estimates. Because of this, the linear growth curve was fitted to the 10-25 day range from when we first measured the chick. No points that were more than 3 days off either end (ie. Before 7 days and after 28 days) were included in the line of best fit.

The average growth rates of wing chord and mass for the years 2005, 2013, 2014, 2015, and 2016 are summarized in the table below (Table 3).

Year	**Average wing chord growth rate (mm/day)**	**Average mass growth rate (g/day)**
2005	4.0	3.0
2013	2.4	2.9
2014	2.8	4.3
2015	3.7	3.9
2016	2.3	3.7

Table 3 Summarized data of average growth rates according to wing chord (mm/day) and mass (g/day) for each year.

Using the numbers above, the average growth rate of wing chord for all the years was calculated to be 2.83 mm/day, and the average growth rate of mass for all the years was calculated to be 3.60 g/day.

The average growth rate for all years was used as a “set zero” to track inter-annual fluctuations from this overall mean (see Fig. 4 and Fig. 5).

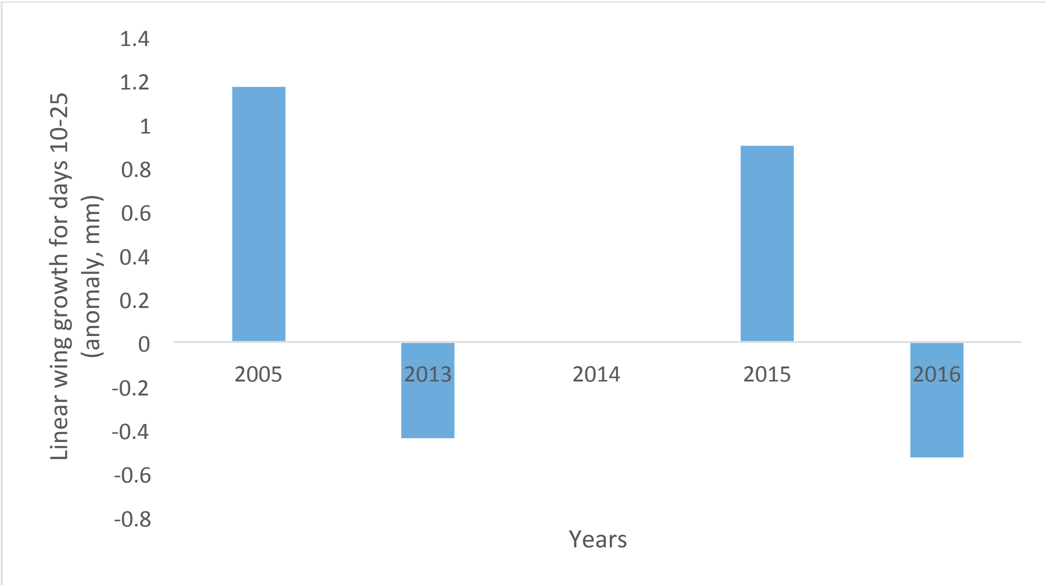

Fig. 4 A graph showing anomalies for linear wing chord growth rate. The overall average (2.83 mm/day) is the set zero, with annual anomalies depicted by the blue bars.

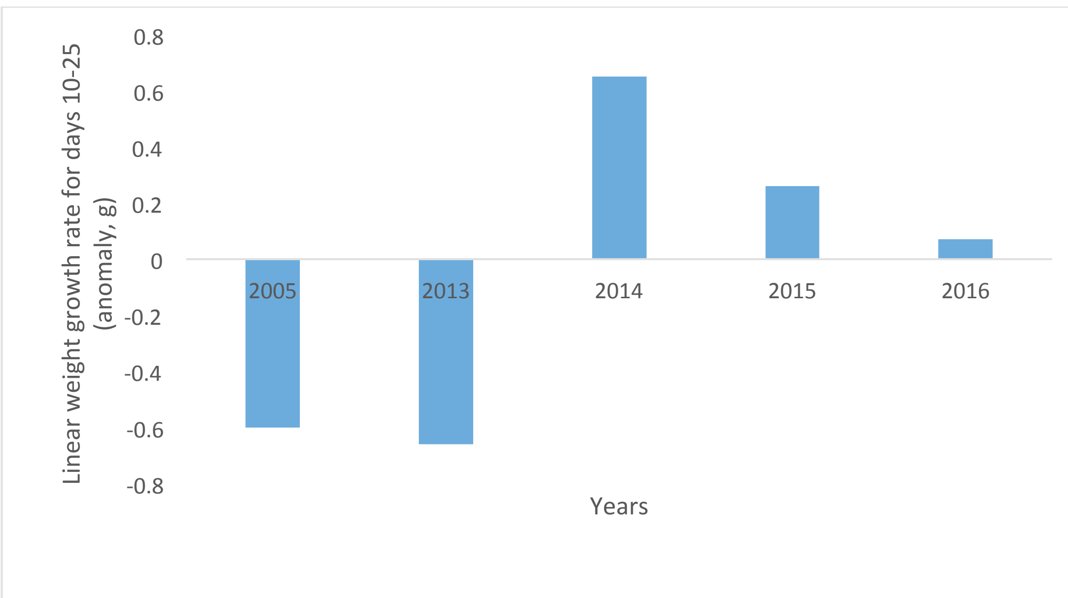

Fig. 5 A graph showing anomalies for linear mass growth rate. The overall average (3.60 g/day) is the set zero, with annual anomalies depicted by the blue bars.

An anomaly graph was also made of chick weight at 25 days. The average weight for all years was 120.3 g at 25 days of age, which was placed as the "set zero." The chicks' weight at 25 days was often estimated because there was no measurement of the chick on that particular day. The weight was calculated by finding the difference in weight between the two days before and after

25 days and, assuming linear growth, adding however number of grams the chick gained each day until it reached 25 days (see Fig. 6).

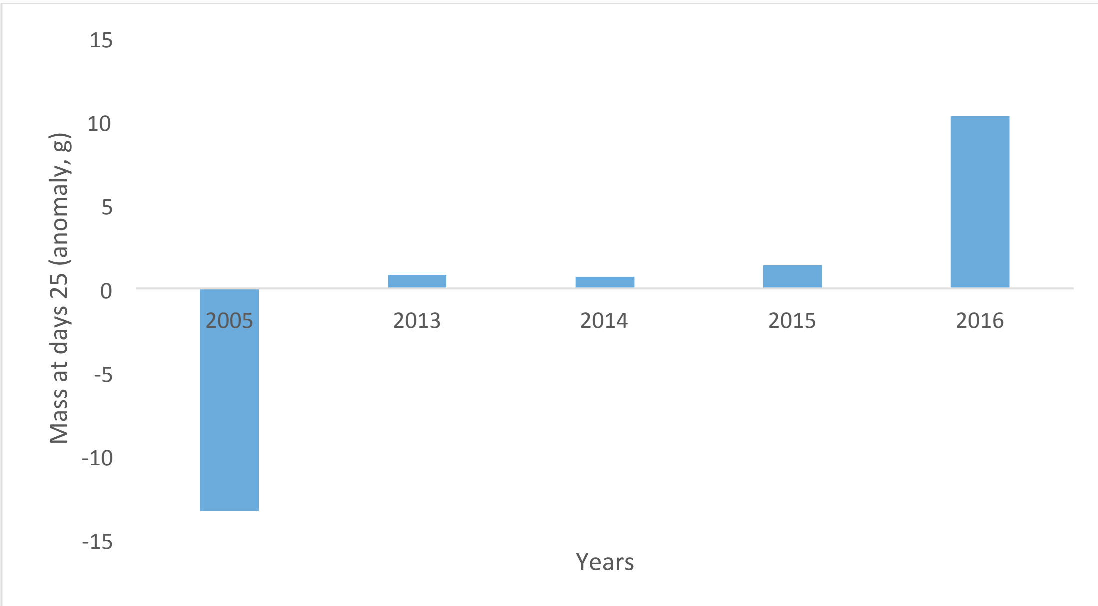

Fig. 6 Graph showing anomalies for chick weight at 25 days old. The overall average (120.3 g) is the set zero, with annual anomalies depicted by the blue bars.

Some chicks that were measured were not included in the average growth rates because the chicks were already too old (ie. More than 25 days of age) when first measured.

Discussion

Methods of measurement at ELI for growth rate were calculated using changes in wing chord and weight over time. Growth rates of wing chord varied between a low of 2.40 mm/day in 2013 to a high of 4.00 mm/day in 2005. Growth rates of weight varied between a low of 2.90 g/day in 2013 to a high of 4.30 g/day in 2014.

Growth rates and estimated chick weights at 25 days of age from ELI were used to compare with those at Triangle Island. The graphs showing anomalies of growth rate and weight at 25 days do not closely match the pattern of anomalies as was calculated at Triangle Island (see Figure 7). The wing chord anomalies do not match the data at Triangle Island for any year, but the mass anomalies fluctuate similarly in 2005 and 2014. The graph of anomalies for weight at 25 days of age has some correlation to that of Triangle Island; 2005 negatively fluctuates as it does on Triangle Island and 2013 and 2014 also positively fluctuate but by a very small amount. Overall, the results do not point towards a strong correlation between the synchronous growth rates of these two populations. However, some considerations for the possible differences must be taken into consideration.

There were only 5 years of collected data on East Limestone Island that were used in the calculations for growth rate and mass, rather than the 20 years at Triangle Island. Also, every year the number of chicks differed, from 1 year in 2005 to 8 chicks in 2013. Because of this variability, the averages may be distorted as some years have a disproportionate influence on the average. Also, since there were relatively few chicks in each year, it is hard to say whether other factors such as local environmental influences could have obscured the effect from larger oceanic effects.

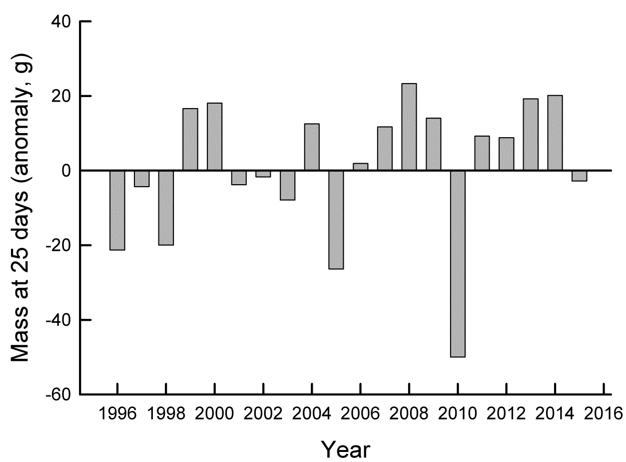

Figure 7 A table showing inter-annual anomalies of Cassin's Auklet chick mass at 25 days old. Credits to Mark Hipfner.

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Appendix

All my spreadsheets are included in an attached Excel file.