Dunstan cave Oilbird *(Steatornis carepensis)* Analysis 1969 to 2013

By AWNC

Introduction

The Dunstan Oilbird cave is located on property owned by the Asa Wright Nature Centre (AWNC) with exact location 61^{o} $17^{/}$ $51.31^{//}$ N and 10^{o} $42^{/}$ $55.29^{//}$. Annual counts of the bird population have been conducted since 1969. From 1998 counts are done more frequently however there has not been any year when counts were done for all 12 months. Because of natural and external pressures including quarrying within the birds' foraging range, it was necessary to analyse the existing data.

Abstract

An analysis on data for the population of oilbirds in the Dunstan Cave was conducted. The analysis looked at the overall population trend for the entire period. From 1998 further analysis on the eggs and chick population trends was conducted.

The overall population growth was found to be 3.5% per year. However, it was found that from the period 1971-1984 there was an unexplainable rapid increase in population growth followed by a rapid decrease and then another increase before the population growth became stable. There no clear modal figure derived due to the fact that the population experienced active growth. Ten percent (10%) of the study time (54 years) the population was found to be less than 100 birds; 53% of the time the population was between 100 and 150 birds: 36% of the time the population was between 150 and 200 birds. On two occasions only, the population was more than 200 birds; in both cases it was 203.

During the calendar year, the first half of the year was shown to be more important for the bird as there were more adults, eggs and chicks observed during this time. In spite of this, there was no clear correlation of statistical consequence between adult, eggs and chicks for any calendar year, suggesting that there were errors in the egg and chick counting exercises.

Information regarding the effect of environmental factors on the population for any particular year was not available for consideration. During the study period, 2013 was the only year when no eggs were observed for the first three months. This must be cause for great cause for concern since on average 48% of the total eggs counted was between January to March.

It is recommended that the counting process be improved to recognize the physiological states of juvenile and immature birds also.

Methodology

Annual population averages for the period 1998 – 2013 were used together with annual counts from 1969 to 1996 to determine adult population trends.

Sample average was used to determine average annual population of adult bird, egg and chick population from 1998-2013. while data for 1969-1996 was obtained from direct counts.

The average growth rate was determined by $Nt = No\ e^{rt}$

A comparison of averages was done for each calendar month from1998 to 2013 for adult birds, chicks and eggs. Regression analysis with Gretl 32 was used to determine correlation among the adult birds, chicks and eggs .

Data

Annual counts from 1969 to 1997. Monthly counts of adults chicks and eggs from 1998 to October 2013 with some missing months as follows:

Year	Adults
1969	36
1970	37
1971	43
1972	43
1973	49
1974	64
1975	74
1976	102
1977	118
1978	129
1979	147
1980	152
1981	123
1982	105
1983	50
1984	1
1985	48
1986	59
1987	59
1988	96
1989	102
1990	138
1991	120
1992	133
1993	132
1994	138
1995	99
1996	118

Month	Year	Adults	Chicks	Eggs
Jan	1998	145	0	0
Mar	1998	153	25	0
Nov	1998	119	0	0
Dec	1998	142	0	4

Month	Year	Adults	Chicks	Eggs
Mar	1999	131	3	1
Jun	1999	142	53	0
Oct	1999	144	0	0

Month	Year	Adults	Chicks	Eggs
Apr	2000	160	19	5
May	2000	157	15	4
Dec	2000	134	0	0

Month	Year	Adults	Chicks	Eggs
May	2001	105	0	1
Nov	2001	99	3	0
Dec	2001	103	0	2

Month	Year	Adults	Chicks	Eggs
Jul	2002	120	5	1
Sep	2002	127	5	0
Oct	2002	132	11	0
Dec	2002	120	0	0

Month	Year	Adults	Chicks	Eggs
Mar	2003	136	6	6
Jun	2003	129	20	2
Sep	2003	119	0	0
Oct	2003	131	4	0
Dec	2003	154	0	0

Month	Year	Adults	Chicks	Eggs
Jan	2004	131	0	6
Mar	2004	130	25	0
Apr	2004	135	26	3
May	2004	123	4	0
Jun	2004	117	1	0
Jul	2004	123	0	0
Sep	2004	146	0	0
Oct	2004	130	0	0
Nov	2004	116	0	0
Dec	2004	137	0	0

Month	Year	Adults	Chicks	Eggs
Jan	2005	145	0	0
Feb	2005	139	0	4
Mar	2005	140	0	2
Apr	2005	162	38	4
May	2005	135	13	0
Jun	2005	132	12	0
Sep	2005	131	0	0
Oct	2005	128	1	0
Nov	2005	133	0	0
Dec	2005	130	0	9

Month	Year	Adults	Chicks	Eggs
Jan	2006	142	0	4
Feb	2006	147	13	2
Mar	2006	143	10	0
May	2006	140	1	0
May	2006	171	0	0
Jul	2006	166	25	0
Sep	2006	142	9	0
Oct	2006	137	6	0
Nov	2006	157	4	0
Dec	2006	154	4	0

Month	Year	Adults	Chicks	Eggs
Jan	2007	169	11	26
Feb	2007	161	16	14
Mar	2007	143	41	0
Apr	2007	172	32	0
May	2007	163	7	0
Jun	2007	164	0	0
Sep	2007	144	3	2
Oct	2007	146	3	0
Nov	2007	141	2	0
Dec	2007	144	0	0

Month	Year	Adults	Chicks	Eggs
Jan	2008	175	16	0
Feb	2008	175	25	0
Mar	2008	187	9	0
Apr	2008	178	2	0
May	2008	178	2	0
Jun	2008	203	5	0
Jul	2008	174	8	0
Sep	2008	187	0	0
Oct	2008	159	0	2
Nov	2008	171	0	0
Dec	2008	168	0	4

Month	Year	Adults	Chicks	Eggs
Jan	2009	154	4	0
Feb	2009	172	16	11
Mar	2009	171	0	2
Apr	2009	186	8	2
May	2009	165	9	0
Jun	2009	127	1	0
Jul	2009	127	0	0
Sep	2009	203	0	0
Oct	2009	172	2	0

Month	Year	Adults	Chicks	Eggs
Jan	2010	175	0	0
Feb	2010	175	2	4
Mar	2010	178	11	10
Apr	2010	0	0	0
May	2010	144	1	0
Jun	2010	162	4	0
Jul	2010	154	0	0
Sep	2010	137	1	2
Oct	2010	147	5	1
Nov	2010	169	0	6
Dec	2010	164	7	9

Month	Year	Adults	Chicks	Eggs
Jan	2011	167	8	6
Feb	2011	171	4	9
Mar	2011	169	10	14
Apr	2011	184	16	13
May	2011	178	19	9
Jun	2011	174	14	11
Jul	2011	164	7	4
Sep	2011	172	5	0
Oct	2011	167	0	1
Nov	2011	169	2	0
Dec	2011	135	7	0

Month	Year	Adults	Chicks	Eggs
Jan	2012	145	2	1
Feb	2012	168	6	4
Mar	2012	126	6	0
Apr	2012	142	6	7
May	2012	192	12	7
Jun	2012	176	11	8
Jul	2012	168	5	9
Sep	2012	134	0	0
Oct	2012	139	0	0
Nov	2012	132	0	0
Dec	2012	138	3	3

Month	Year	Adults	Chicks	Eggs
Jan	2013	130	0	0
Feb	2013	137	0	0
Mar	2013	127	0	0
Apr	2013	140	11	4
May	2013	139	7	2
Jul	2013	174	5	0
Sep	2013	168	2	0

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Discussion

The rapid increase and decrease in the population numbers during the years 1971-1987 remained largely unaccounted for as there is no supporting evidence for an increased population growth from 1976-1980 as seen in Figure 1.

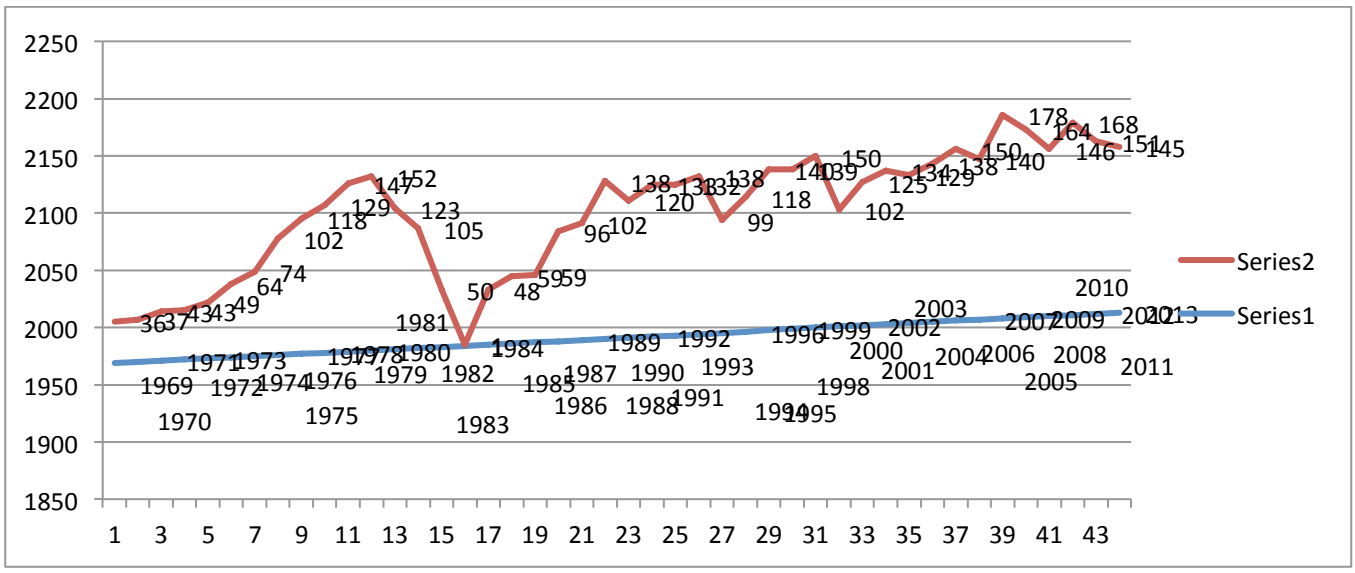

Figure1 shows the population trend from 1969 - 2013

The effect of a predator–prey interaction in this scenario seems plausible from the view that the rapid population growth from 1974 – 1980. This could be possible if the predator population had greatly declined for a period. As the bird population increased, the predator population followed by

an undetermined lagged value. As the predator continuously preyed on the bird population and its numbers began to decrease rapidly, there was also a decrease in the predator population until it both populations reached an equilibrium level.

This rational is supported in particular by the data from 1983, 1984 and 1985 when the population count decreased from 48 birds in 1983 to a single bird in 1984 and increased back 50 birds in 1985. It is possible that the predator entered the cave causing the birds to take flight temporarily prior to the 1984 count leaving one single bird and returning prior to the 1985 count. The doubling of the population from 1984 to 1989 would appear that there was an annual growth rate of 18%. Even though there is no egg and chick data for that period, the available egg and chick count which is available suggests that such rate of growth is highly unlikely. Therefore one has to conclude that as the predator problem declined, birds gradually returned to the cave over time.

During the first half of the year the counting exercises revealed increases in the adult birds, eggs and chicks. However, the increase in adult birds was not as prominent as the increase in eggs and chicks.

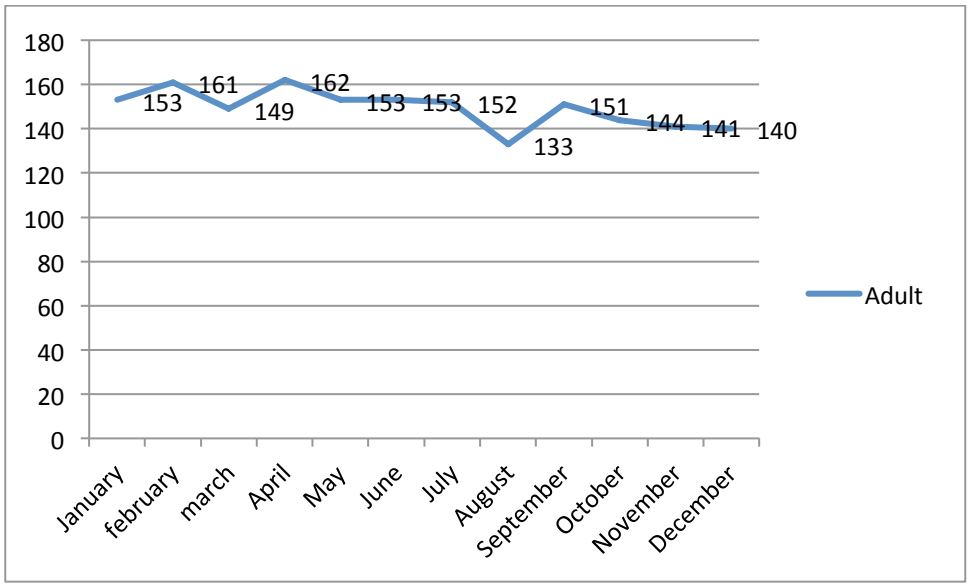

Figure 2. shows average monthly adult bird population trend for the period 1998- 2013

Most eggs were counted in February, January, April and May respectively with an average of 4 eggs per month. The months in which the least eggs were counted were August, September, October and November respectively with an average of less than one egg. No eggs were found during August, September and October while there was an average of 1 egg for counts done in November (as seen in Figure 3).

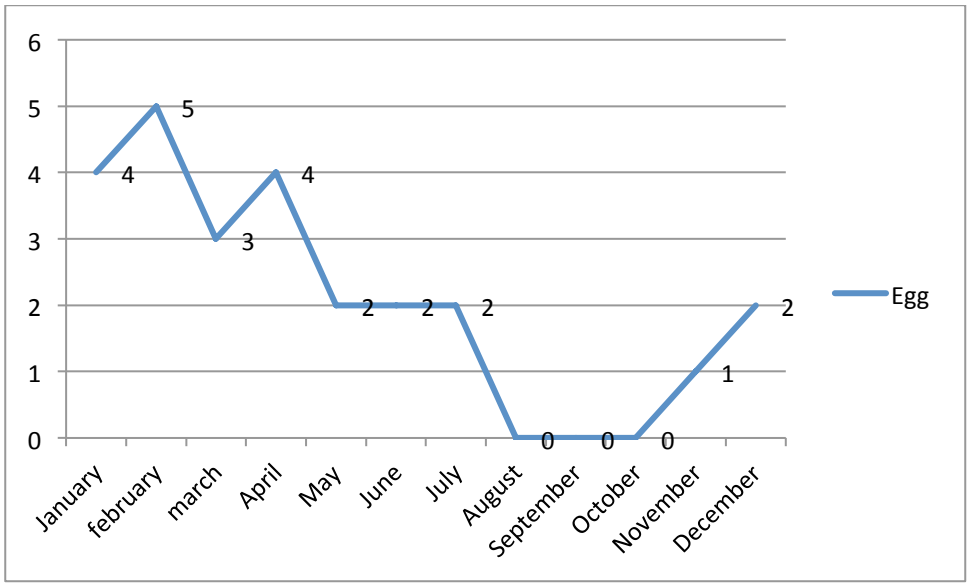

Figure 3. shows average monthly egg count

Most chicks were found during the months of February, March, April, May and June respectively with an average of 9 chicks. September, October, November and December were the months where the least chicks were found averaging 2 chicks per count.

February was found to be the month for which egg production peaked, remaining consistent with peak chick production in April as an egg takes 33 days to hatch (figure 4).

Even as it appeared that the egg chick relationship was more evident than that of adult – chick relationship and the adult – egg relationship, there was no clear significant link among these three production parameters.

Regression analysis where each production parameter was used as a dependent variable and regressed against the other two parameters used as a independent variables supports this (Model 1 ,2 &3).

The negative correlation between egg and chick resulted from the fact that egg numbers counted were most likely underestimated. As the counting process took place, many eggs were missed as they were laid in locations which made it difficult to be observed during the exercise.

No calendar year during the study period seem to have favoured the bird population in terms of the three (3) parameters. The year 2002 however was not a good one because all of the production parameters were among the four (4) least values of that category (see table 1).

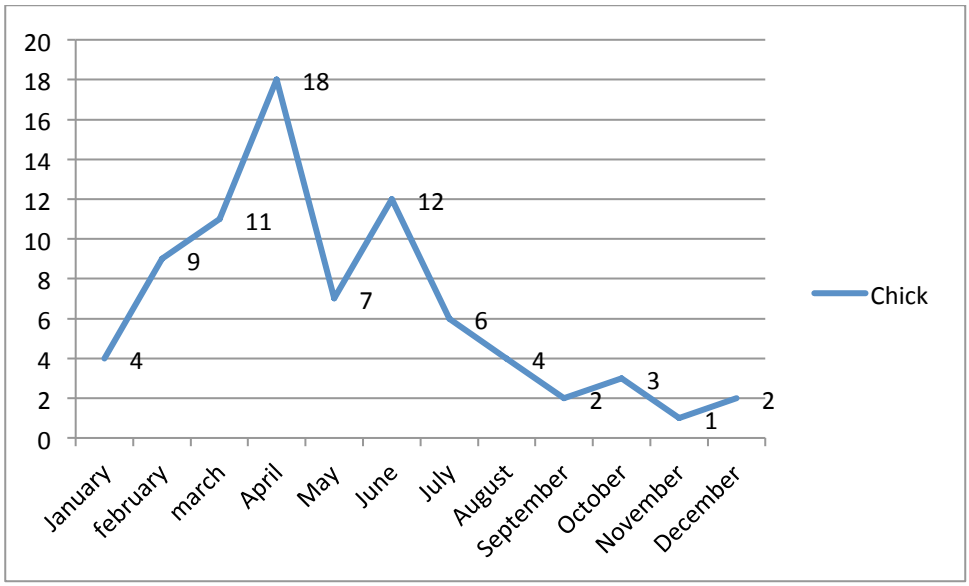

Figure 4. shows average monthly egg count

Model 1: OLS estimates using the 16 observations 1998-2013
Dependent variable: egg

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*p-value*	
const	-2.28356	4.04122	-0.5651	0.58165	
adult	0.0305134	0.0286145	1.0664	0.30566	
chick	-0.0603586	0.119229	-0.5062	0.62116	

Model 2: OLS estimates using the 16 observations 1998-2013
Dependent variable: adult

Variable	Coefficient	Std. Error	t-statistic	p-value	
const	133.121	9.07576	14.6678	<0.00001	***
chick	1.0242	1.08241	0.9462	0.36129	
egg	2.63607	2.47203	1.0664	0.30566	

Model 3: OLS estimates using the 16 observations 1998-2013
Dependent variable: chick

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*p-value*	
const	-2.66662	9.39392	-0.2839	0.78098	
egg	-0.320297	0.632697	-0.5062	0.62116	
adult	0.0629118	0.0664873	0.9462	0.36129	

No correlation between egg production and mean monthly temperature was observed. However a negative correlation was observed between egg production and mean monthly rainfall. There was a positive correlation between mean annual rainfall and population growth. It remains undetermined whether this resulted from direct or indirect impacts (see table 1 and Appendix 1).

Table 1

Physiological state	Year with highest average amount	Average Amount		Year with lowest average amount	Average Amount
Chicks	1999	19		2002	1
Egg	2001	6		2001	< 1
Adults	2008	178		2001	102
Adults	2011	168		2002	125
Egg	2013	5		2002	< 1
Adults	2012	151		2003	134
Chicks	2007	8		2004	3
Adults	2009	164		2004	129
Egg	2010	4		2006	< 1
Egg	2004	3		2008	< 1
Chicks	2000	8		2010	2
Chicks	2001	10		2013	2

Conclusion

The average growth rate from 1969 to 2013 was 3.5% per annum. The cave appears to have a carrying capacity approximating 200 adult birds.

Generally the birds breed more during the first 6 months of the year with the most important months being January and February. The months of August, October and November are the months of least activity.

There was no correlation between the numbers amount of adult birds with the amount of eggs or the amount of chicks suggesting that eggs and chicks were not properly accounted for.

No available information intrinsic or external was identified to be linked to the increased or decreased in numbers of adult birds, eggs or chicks for any particular year.

Recommendations

During the first half of the year the birds should be counted more frequently. A fourth-nightly count will provide better data.

An attempt should be made to recognize other physiological states of the bird's life cycle between chick and adult bird (juvenile or immature birds). This will give an indication as to the quantity of eggs that were missed during the counting process.

Remarks regarding environmental factors which could have a direct and indirect impact on adult population, egg production and chick production should be recorded.

Further studies should be conducted to determine average foraging periods and its likely predators.