APPENDIX H

Avifaunal pre-construction monitoring at the proposed Mainstream Pofadder Wind Energy Facilities:

Overview of methodology

1. Introduction

The pre-construction monitoring protocol was designed in accordance with the *"Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa"* (Jenkins *et al.* 2011) which was published by the Endangered Wildlife Trust (EWT) and BirdLife South Africa (BLSA) in March 2011, and subsequently revised in August 2011 and July 2012.

2. Objectives

The objectives of the avifaunal pre-construction monitoring programme were as follows:

- To establish which species regularly occur at the development site;
- To gather baseline data on the diversity of avifauna and specifically abundance of priority species within the development area to measure potential **displacement** due to the construction and operation of the wind farm. This is primarily done through transect surveys (see 4.1 below).
- To record flight behaviour of priority species to assess the risk of potential mortality due to **collision** with the turbines. This is primarily done through vantage point counts (see 4.2 below).

3. Assumptions and limitations

The basic assumption is that the sources of information used are reliable enough to allow for meaningful interpretation. However, it must be noted that there are certain limitations:

- It is inevitable that observations at vantage points are biased towards those species that are more visible (i.e. larger species), and flights that are closer to the observer. It must therefore be accepted that both the accuracy and frequency of observations decrease with distance from the observer. It should also be noted that the survey method i.e. an observer using binoculars is inherently not very accurate when it comes to judging flight height, therefore flight height should be seen as an approximation only.
- The best practice guidelines state that "monitoring data should be collected over at least a 12 month period (at both WEF and control sites), and include sample counts representative of the full spectrum of prevailing environmental conditions likely to occur on each site in a year". Whereas the sampling periods in this study aim to be broadly representative of seasonal environmental conditions which prevailed during the monitoring period, it must be borne in mind that environmental conditions may vary significantly on an annual basis, especially in an arid environment like Bushmanland. Furthermore, it is not

always realistically possible to schedule monitoring to coincide with the full spectrum of environmental conditions, due to practical constraints.
- In circumstances where there is uncertainty and the precautionary principle may be relevant, evidence, expert opinion, best practice guidance and professional judgment were applied.
- For purposes of monitoring, priority species were defined as species included on the list of priority species of the Avian Wind Farm Sensitivity Map of South Africa compiled by Birdlife South Africa (Retief *et al.* 2012).

4. Methods

Data were gathered in four sampling seasons at the turbine site and a control site. The seasonal windows are defined as follows:

- Spring: Mid-August to Mid – November.
- Summer: Mid - November to Mid - March.
- Autumn: Mid - March to Mid-May
- Winter: Mid-May to Mid-August

Monitoring was implemented during the following periods:

- Winter: 2 – 8 July 2013
- Spring: 29 October – 4 November 2013
- Summer: 26 February - 4 March 2014
- Autumn: 20 – 28 April 2014

4.1 Transects and vantage points

The monitoring protocol for the site is designed according to the latest version (2012) of *Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.*

The monitoring was conducted at the proposed turbine site and a control site by three field monitors.

Monitoring is conducted in the following manner:
- One drive transect in representative habitat was identified totalling 20.4km on the turbine site and one drive transect in the control site with a total length of 8.05km.
- Two observers travelling slowly (± 10km/h) in a vehicle records all priority species on both sides of the transect. The observers stop at regular intervals (every 500 m) to scan the environment with binoculars. Transects are counted three times per seasonal sampling session.
- In addition, three walk transects of 1km each in representative habitat were identified at the turbine site, and two at the control site. All birds are recorded during walk transects, not only priority species.
- The following variables are recorded:

    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Distance from transect (0-50 m, 50-100 m, >100 m);
    - Wind direction;
    - Wind strength (calm; moderate; strong);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
    - Co-ordinates (priority species only).

- Six vantage points (VPs) were selected from which the majority of the proposed turbine area can be observed (the "VP area"), to record the flight altitude and patterns of priority species. The following variables were recorded for each flight:
    - Species;
    - Number of birds;
    - Date;
    - Start time and end time;
    - Wind direction;
    - Wind strength (estimated Beaufort scale 1-7);
    - Weather (sunny; cloudy; partly cloudy; rain; mist);
    - Temperature (cold; mild; warm; hot);
    - Flight altitude (high i.e. >180 m; medium i.e. 40-180 m; low i.e. <40 m)
    - Flight mode (soar; flap; glide ; kite; hover); and
    - Flight time (in 15 second-intervals).

The aim with drive transects is primarily to record large priority species (i.e. raptors and large terrestrial species), while walk transects are primarily aimed at recording small passerines. The objective of the transect monitoring is to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind farm activities. The objective of vantage point counts is to measure the potential collision risk with the turbines. Priority species were identified using the January 2012 BLSA list of priority species for wind farms.

Figures 1 the location of the VPs, transects, focal points and the proposed turbine lay-out.

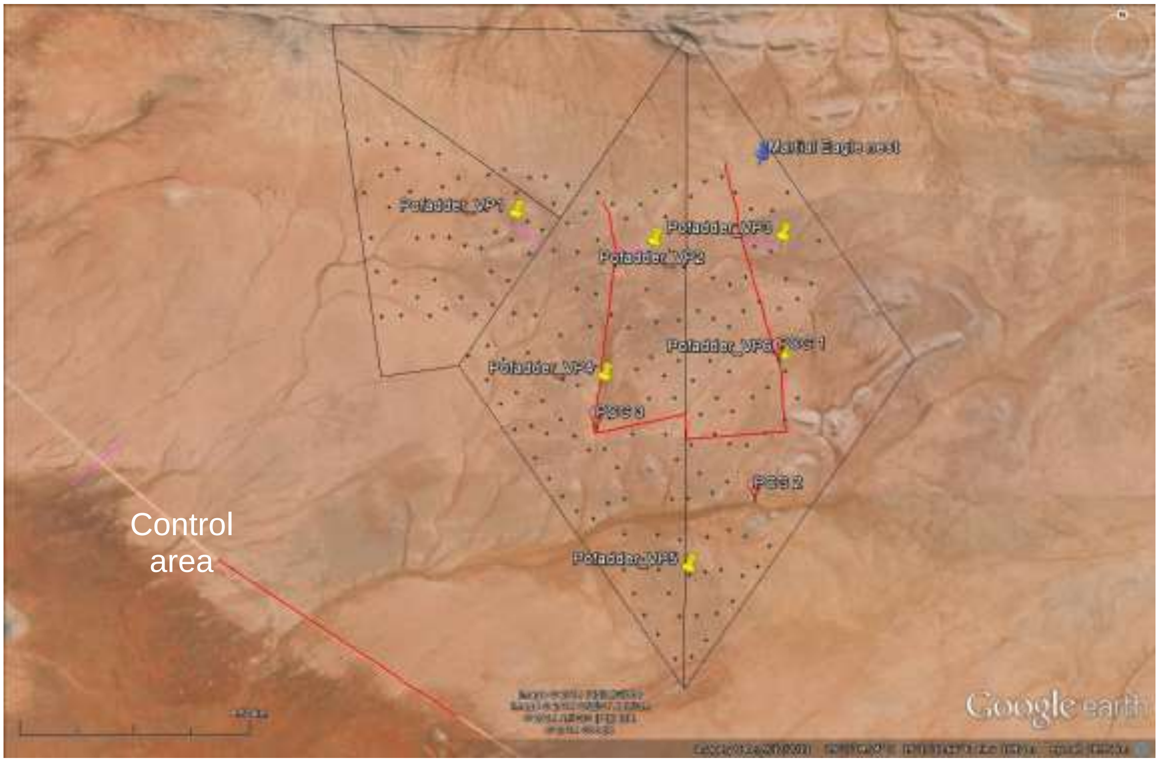


Figure 1: Turbine site indicating the turbine site drive transects (red line), turbine vantage points (VPs) (yellow placemarks), walk transects (purple lines), turbine positions (dots) and focal points (Martial Eagle and Southern Pale Chanting Goshawk nests).

4.2 Focal point counts

A Martial Eagle nest and three Southern Pale Chanting Goshawk nests were recorded during the monitoring (see Figure 1). All nests were monitored once every season to establish the status of the nests.

APPENDIX B: BIRD HABITAT

Figure1: An example of Bushmanland Arid Grassland at the site. This is the typical habitat in the majority of the site.

Figure 2: The inactive Martial Eagle nest at the site on tower 147 of the Aggeneys – Aries 400kV.

Figure 3: A drainage line in the WEF site showing habitat where Red Lark was mostly recorded.

Figure 4: A water point in the WEF site. Note the small trees which are used by Southern Pale Chanting Goshawk as nesting sites.

Figure 5: A cobble-strewn ridge with Bushmanland Inselberg Shrubland.

Figure 6: The nest of a Southern Pale Chanting Goshawk at one of the water points.

APPENDIX C: STATISTICAL ANALYSIS

5. Introduction

The data on which this report is based are contained in the MS Excel file "*Pofadder VP Data Wi Sp Su Au 20141010_v1.xls*". This file contains records for each individual flight of priority species birds that were recorded at each of six vantage points and for every two-hour watch period during the survey. The survey covers four seasons of the year and took place during the dates indicated in Table 1. Environmental and other relevant information were also recorded, including watch periods where no birds were recorded.

Table *1*. The survey dates.

Start Date	End Date	Season	Number of Days
2013-07-02	2013-07-07	Winter 2013	6
2013-10-29	2013-11-03	Spring 2013	6
2014-02-23	2014-03-04	Summer 2014	10
2014-04-20	2014-04-28	Autumn 2014	9

There were 36 watch periods of two hours each allocated to every season and spread over the six vantage points from where the observations were made.

Some basic statistics concerning the data set are investigated and reported here, including the matter of the extent to which the data obtained are representative of the true occurrence of those birds identified as priority species in the area.

6. Descriptive statistics

A count of the total number of individual birds observed during the survey against the *Height* at which they flew are extracted (by species) and presented in Table A in the *Appendix*. Table B shows the times that the soaring and terrestrial birds flew at medium height and at all heights. Tables C – F (also in the Appendix) provide summary statistics that give insight into the behaviour of the species observed w.r.t. their presence according to season and their occurrence profiles during various weather conditions such as temperature, wind direction and wind speed.

The counts observed during consecutive watch periods, also identified by season and by vantage point, are listed separately in Tables H and I in the *Appendix* for *Soaring* and *Terrestrial* birds separately and with calculations of updated average counts for consecutive watch periods.

The computations were done using STATISTICA statistical software (see StatSoft Inc., 2013) and with routines developed for this purpose in "Statistica Visual Basic", the programming language of STATISTICA.

Averages & variability of counts

The descriptive statistics of average counts, standard deviations (Std.Dev.) and 95% lower and upper confidence intervals (LCL and UCL) for the mean count per watch period for the data in each of the four seasons are computed from the data leading to Tables G and H and the results are listed in Tables 2 – 4. The number of individual birds are recorded for each flight (*"flight"* being used here for a group of birds flying or associating together). Thus Tables *2* and *4* report the statistics for the number of *flights* recorded over all watch periods. Tables *3* and *5* report the statistics for the total number of individual birds per watch period.

Table *2*. Soaring birds, Flights: average, SD and 95% lower and upper confidence limits for the number of Flights per watch period.

Season	Watch periods	Soaring birds: Flights				
		Count	Avge	Std.Dev.	95% LCL	95% UCL
Winter	36	7	0.19	0.58	-0.00	0.39
Spring	36	27	0.75	1.76	0.15	1.35
Summer	36	20	0.56	0.91	0.25	0.86
Autumn	36	13	0.36	0.87	0.07	0.65
All Grps	144	67	0.47	1.13	0.28	0.65

Table *2*, for example, shows that *67* flights of soaring birds were counted during the *144* watch periods, leading to an estimated average of *0.47* flights per *2*h watch period with a *95%* confidence interval of *0.28 – 0.65*. The data for the seasons are similarly interpreted.

Tables *3 – 5* are interpreted in the same way as in the examples just described.

Table 3. Soaring birds, Individuals: average, SD and 95% lower and upper confidence limits for the number of Individuals per watch period.

Season	Watch periods	Soaring: Individuals				
		Count	Avge	Std.Dev.	95% LCL	95% UCL
Winter	36	7	0.19	0.58	-0.00	0.39
Spring	36	32	0.89	2.48	0.05	1.73
Summer	36	21	0.58	1.00	0.25	0.92
Autumn	36	15	0.42	1.02	0.07	0.76
All Grps	144	75	0.52	1.47	0.28	0.76

Table 4. Terrestrial birds, Flights: average, SD and 95% lower and upper confidence limits for the number of Flights per watch period.

Season	Watch periods	Terrestrial: Flights				
		Count	Avge	Std.Dev.	95% LCL	95% UCL
Winter	36	28	0.78	1.71	0.20	1.36
Spring	36	22	0.61	1.76	0.02	1.21
Summer	36	20	0.56	1.16	0.16	0.95
Autumn	36	32	0.89	1.51	0.38	1.40
All Grps	144	102	0.71	1.54	0.45	0.96

Table 5. Terrestrial birds, Individuals: average, SD and 95% lower and upper confidence limits for the number of Individuals per watch period.

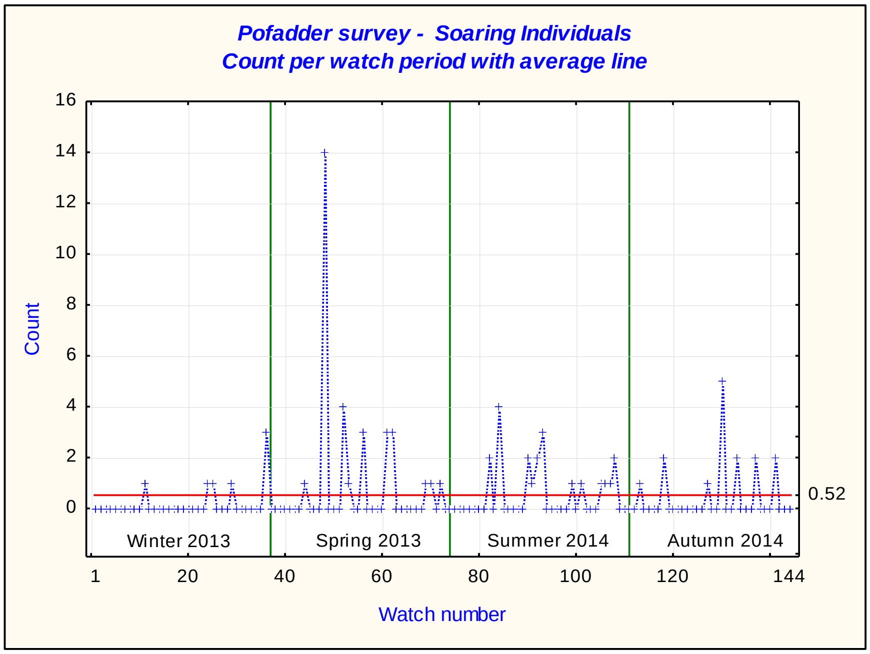
Season	Watch periods	Terrestrial: Individuals				
		Count	Avge	Std.Dev.	95% LCL	95% UCL
Winter	36	89	2.47	6.41	0.30	4.64
Spring	36	63	1.75	6.38	0.00	3.91
Summer	36	27	0.75	1.59	0.21	1.29
Autumn	36	78	2.17	3.82	0.87	3.46
All Grps	144	257	1.78	4.96	0.97	2.60

Tables *5* shows that individual terrestrial birds showed an average count of *1.78* individuals per *2*h watch period with an estimated *95%* confidence interval of *1.78 ± 0.81* for individuals per *2*h watch period.

Stability and Representativeness

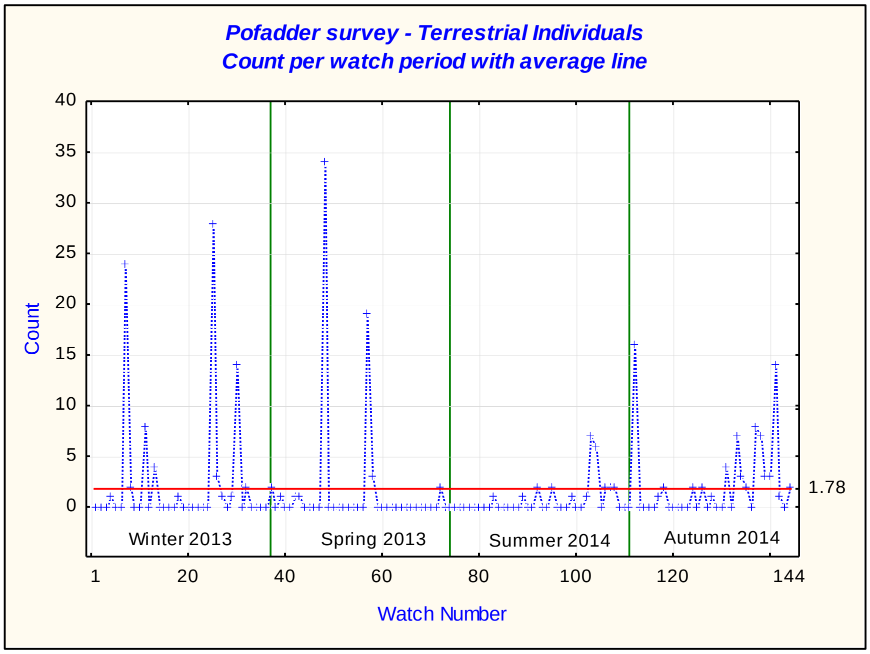
The standard deviations given in Tables *2 – 5* are measures of the variability that exists in the counts observed. The variability of the counts are visualised for individual counts in Figures *1* (Soaring *individuals*) and *2* (Terrestrial *individuals*).

Figure *1*: Soaring birds: sequential time plot of individual soaring bird counts.



It has to be noted that many runs of zero counts were encountered during all seasons. Figure *1* visually confirms the result in Table *3* that the standard deviation in Spring could be more than four times as large as in Winter.

Figure *2*: Terrestrial birds: sequential time plot of individual terrestrial bird counts.



Insight into the representativeness and stability of the counting process may also be obtained in another way. As the data are gathered watch period by watch period an improved estimate of the average number of birds that occur in the area will be achieved. As more data are gathered the more accurate the estimate will become. The issue is to determine if the updated average count begins to stabilise towards the end (or better still, before the end) of the survey (and thus the conclusion that a representative sample has been achieved).

To achieve this, the average number of flights (as well as for individual birds) is computed from all preceding data as the data become available in consecutive watch periods (day after day and from the different vantage points). These updated averages are expected to vary to a large extent in the initial stages of sampling and to stabilise as more data come in. Since the counts vary (in principle) substantially over the seasons (especially for individual counts) the updated averages are determined separately for each season and are listed in Tables H and I in the Appendix.

Figure 3 plots these updated averages for Soaring birds (the number of flights as well as a count of the total number of individual birds). Figure 4 does the same for Terrestrial birds.

Figure 3. **Soaring birds: updated average for *Flight* and *Individual* counts, separately by season.**

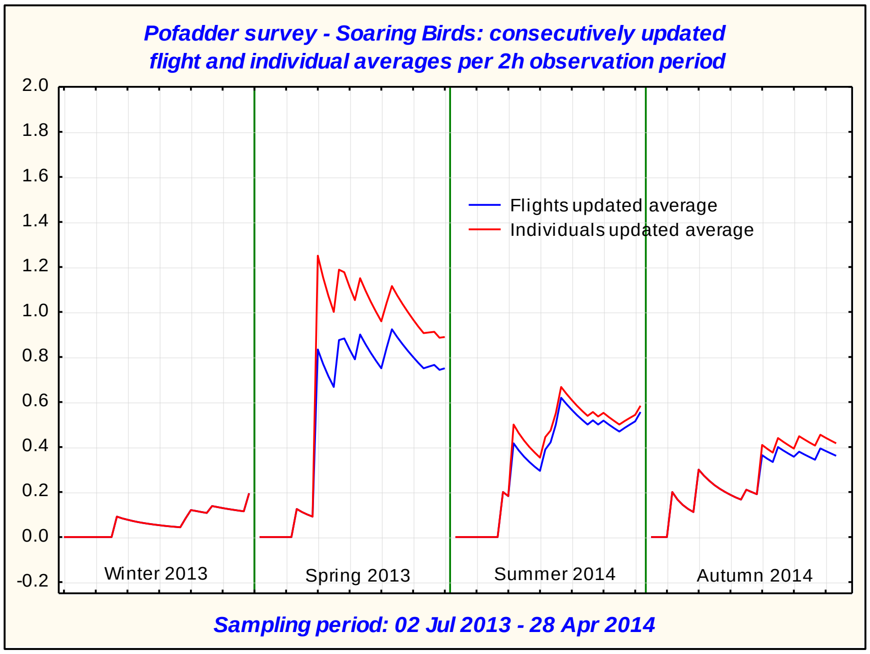


Figure *3* shows that the updated averages stabilise well towards the end of Winter, Spring, Autumn but shows a small but possibly insignificant) upward trend towards the end of Summer which does not seem to be a seriously bothersome trend.

Figure *4*. Terrestrial birds: updated average for *Flight* and *Individual* counts, separately by season.

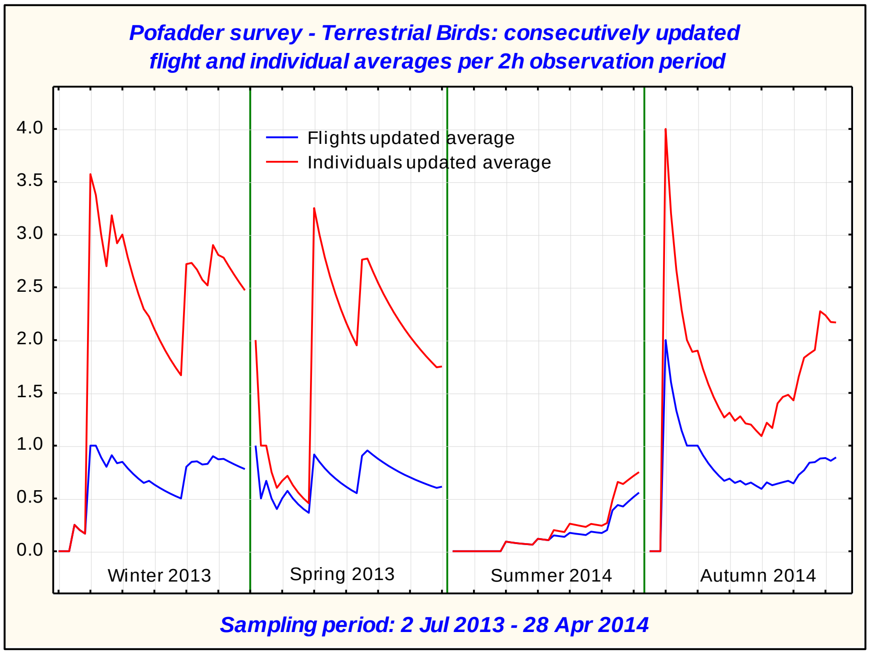
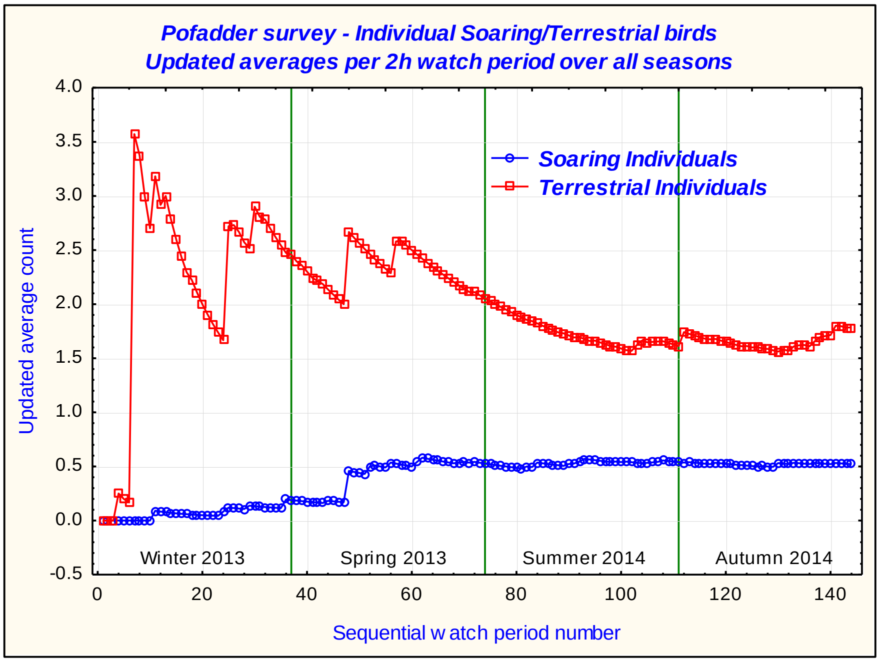


Figure *4* shows that the updated averages stabilise well towards the end for the Winter and Spring 2013 seasons. Even though there are quite small number of birds observed it appears as if there is still an increase in counts at the end of the Summer and Autumn 2014 seasons.

When the updated averages are computed, not separately for each season, but continuously over all consecutive watch periods over all four seasons, the picture becomes much clearer as shown in Figure *5*. This is done for individual counts only.

Figure *5* shows how the updated average counts are on a stabilising trend towards the end of a year of counts over all four seasons. It is thus not expected that further sampling will succeed in changing the estimated average number of individual birds in the area in a substantial way.

Figure *5*. Soaring and Terrestrial birds: updated average for *Individual* counts.



Sample size

There is another way to consider if the sample size is sufficient for the intended purpose namely to estimate the average number of birds with acceptable precision. The standard deviations given in Tables *2 – 5* are measures of the variability that exists in the counts observed. To achieve a computation for sample size we consider the variabilities for soaring individuals only.

The technical question is: how many watch periods (n) must be sampled in order to be *95%* certain of obtaining an estimate of the mean that is within a precision of "d" units (counts) from the true mean value, i.e. to say with *95%* certainty that the true mean count per observation period lies in an interval of $\bar{x} \pm d$ where $\bar{x}$ is the sample estimate of the true mean value. A practical approximation to an appropriate sample size for this requirement may be obtained from the formula:

(*1*) $$n = (s * t_{\alpha/2}(n-1) / d)^2,$$

where $t_{\alpha/2}(n-1)$ is the upper $\alpha/2$ = 2.5% point of Student's t distribution with $n - 1$ degrees of freedom (n the sample size) and s is an estimate of the true standard deviation of the counts (see Zar, *2010*, page *115*).

The Spring counts for soaring individuals, with an average of *0.89* and standard deviation of *2.48* are meaningfully different from those of the other three seasons. This is the worst case scenario since that season has the largest variance. If the sample size of *n = 36* is sufficient to guarantee a certain precision then the other sample sizes (at seasons with smaller variances) will also be sufficiently large.

If a value of *d = 1* is considered to be adequate precision for the Spring counts, then, by applying formula (1) with *s = 2.48* (see Table 3), a sample size of *n ≈ 26* will achieve this. The *n = 36* that were used during the survey is thus sufficient for this precision. Note that the achieved precision, using a sample size of *n = 36* and the width of the listed confidence interval is *d = (1.73 – 0.05)/2 = 0.84* which is a precision better than the proposed *d = 1*.

When the terrestrial birds (individual counts) are considered, Table *5* shows *s = 6.41* to be the largest standard deviation. The sample size of *n = 36* achieved a precision of *d = (4.64 – 0.30)/2 = 2.17* using the confidence interval (on which formula *(1)* is based). If a precision of *d = 1* is required, formula (*1*) shows the minimum sample size has to be *n ≈ 170*. This is impractical and it has to be accepted that a precision of *d* ≈ 2 will have to suffice. However, to estimate the average number of birds to be within ±*2* where the average count per watch period is low (±*2.5*) is probably as precise as may be expected.

All told we may conclude that the sample sizes used during the survey would provide information sufficient to characterise the average number of birds in the area with reasonable certainty.

The use of formula (*1*), and equivalently the computation of the confidence interval, is dependent on certain assumptions (e.g. normality of the counts distribution) that are perhaps not met. However, it should provide a reasonable indication of the validity of the estimates based on the achieved sample sizes.

7. Conclusion

The computations and the way the data were exhibited in the tables and graphs in this report show that the survey may be taken to be statistically representative of the soaring and terrestrial priority species of birds that occur in the area and that more data would not succeed in improving the estimates in a substantial way.

8. References

StatSoft, Inc., (2013), STATISTICA (data analysis software system), Version 12. www.Statsoft.com.

Zar, J.H., (2010), *Biostatistical Analysis* (5th ed.), Prentice-Hall, Inc., Upper Saddle River: NJ 07458.

APPENDIX

Table A. Number of individual priority species birds recorded during the survey by Species, Flight Class and Flying Height distribution.

Species	Flight Class	Flying Height			Row Totals
		Low	Medium	High	
Southern Pale Chanting Goshawk	Soaring	56	6	0	62
Greater Kestrel	Soaring	10	2	0	12
Black-Chested Snake-Eagle	Soaring	0	0	1	1
Count (Soaring)		66	8 (10.7%)	1	75
Ludwig's Bustard	Terrestrial	28	26	8	62
Northern Black Korhaan	Terrestrial	18	5	0	23
Sclater's Lark	Terrestrial	145	0	0	145
Karoo Korhaan	Terrestrial	26	0	0	26
Red Lark	Terrestrial	1	0	0	1
Count (Terrestrial)		218	31	8	257
Total count (Overall)		284	39 (11.7%)	9	332

Table B. Number of individual priority species birds recorded during the survey by Species, Flight Class, Flight Duration (seconds) at Medium Height and the latter as a percentage of total Flight Duration at all heights.

Species	Flight Class	Valid N and Flight Duration (seconds)				
		At Medium Height		At All Heights		Time at Medium Ht
		N	Time (sec)	N	Time (sec)	
Southern Pale Chanting Goshawk	Soaring	6	525	62	4200	12.5%
Greater Kestrel	Soaring	2	195	12	1065	18.3%
Black-Chested Snake-Eagle	Soaring	0	0	1	150	0.0%
Count (Soaring)		8	720	75	5415	13.3%
Ludwig's Bustard	Terrestrial	26	2820	62	5925	47.6%
Northern Black Korhaan	Terrestrial	5	615	23	1665	36.9%
Sclater's Lark	Terrestrial	0	0	145	5790	1.6%
Karoo Korhaan	Terrestrial	0	0	26	2040	0.0%
Red Lark	Terrestrial	0	0	1	45	0.0%

Count (Terrestrial)	31	3435	257	15465	22.2%
Total count (Overall)	39	4155	332	20880	19.9%

Table C: Number of individual priority species birds recorded by Species, Flight Class and Season.

Species	Flight Class	Season				Row Totals
		Winter	Spring	Summer	Autumn	
Southern Pale Chanting Goshawk	Soaring	7	27	17	11	62
Greater Kestrel	Soaring	0	5	3	4	12
Black-Chested Snake-Eagle	Soaring	0	0	1	0	1
Count (Soaring)		7	32	21	15	75
Northern Black Korhaan	Terrestrial	1	2	16	4	23
Sclater's Lark	Terrestrial	74	53	6	12	145
Karoo Korhaan	Terrestrial	11	6	4	5	26
Ludwig's Bustard	Terrestrial	3	2	1	56	62
Red Lark	Terrestrial	0	0	0	1	1
Count (Terrestrial)		89	63	27	78	257
Total count (Overall)		96	95	48	93	332

Table D: Number of individual priority species birds recorded by Species, Flight Class and Temperature.

Species	Flight Class	Temperature				Row Totals
		Cold	Mild	Warm	Hot	
Southern Pale Chanting Goshawk	Soaring	28	17	9	8	62
Greater Kestrel	Soaring	0	9	1	2	12
Black-Chested Snake-Eagle	Soaring	0	1	0	0	1
Count (Soaring)		28	27	10	10	75
Northern Black Korhaan	Terrestrial	3	14	4	2	23
Sclater's Lark	Terrestrial	129	6	10	0	145
Karoo Korhaan	Terrestrial	19	5	2	0	26
Ludwig's Bustard	Terrestrial	46	3	13	0	62

Red Lark	Terrestrial	1	0	0	0	1
Count (Terrestrial)		198	28	29	2	257
Total count (Overall)		226	55	39	12	332

Table E: Number of individual priority species birds, by Species, Flight Class and Weather Condition

Species	Flight Class	Weather condition			
		Cloudy	Partly Cloudy	Sunny	Row Totals
Southern Pale Chanting Goshawk	Soaring	2	49	11	62
Greater Kestrel	Soaring	0	7	5	12
Black-Chested Snake-Eagle	Soaring	0	1	0	1
Count (Soaring)		2	57	16	75
Northern Black Korhaan	Terrestrial	0	22	1	23
Sclater's Lark	Terrestrial	19	94	32	145
Karoo Korhaan	Terrestrial	4	7	15	26
Ludwig's Bustard	Terrestrial	2	50	10	62
Red Lark	Terrestrial	0	1	0	1
Count (Terrestrial)		25	174	58	257
Total count (Overall)		27	231	74	332

Table F: Number of individual priority species birds recorded by Species and Wind Direction.

Species	Flight Class	Wind Direction								Row Totals
		N	NE	E	SE	S	SW	W	NW	
Southern Pale Chanting Goshawk	Soaring	1	2	8	3	6	19	14	9	62
Greater Kestrel	Soaring	0	0	0	1	0	8	2	1	12
Black-Chested Snake-Eagle	Soaring	0	1	0	0	0	0	0	0	1
Count (Soaring)		1	3	8	4	6	27	16	10	75
Northern Black Korhaan	Terrestrial	2	0	3	9	1	2	5	1	23
Sclater's Lark	Terrestrial	0	6	2	60	0	53	0	24	145
Karoo Korhaan	Terrestrial	0	4	5	6	0	6	0	5	26
Ludwig's Bustard	Terrestrial	3	11	30	1	0	3	2	12	62
Red Lark	Terrestrial	0	0	1	0	0	0	0	0	1
Count (Terrestrial)		5	21	41	76	1	64	7	42	257
Total count (Overall)		6	24	49	80	7	91	23	52	332

Table G: Number of individual priority species birds recorded by Species, Flight Class and Wind Strength (Beaufort scale).

Species	Flight Class	Beaufort scale					Row Totals
		Light Air	Light Breeze	Gentle Breeze	Moderate Breeze	Strong Breeze	
Southern Pale Chanting Goshawk	Soaring	4	16	29	12	1	62
Greater Kestrel	Soaring	0	0	2	10	0	12
Black-Chested Snake-Eagle	Soaring	0	1	0	0	0	1
Count (Soaring)		4	17	31	22	1	75
Northern Black Korhaan	Terrestrial	8	5	5	5	0	23
Sclater's Lark	Terrestrial	0	79	66	0	0	145
Karoo Korhaan	Terrestrial	2	9	11	4	0	26
Ludwig's Bustard	Terrestrial	0	26	30	6	0	62
Red Lark	Terrestrial	0	1	0	0	0	1
Count (Terrestrial)		10	120	112	15	1	257
Total count (Overall)		14	137	143	37	1	332

Table H: ***Soaring Birds*: Flights and Individuals for priority species per watch period and by vantage point over time with updated averages per consecutive watch period.**

Watch Number	Date	Season	VP	Flights count	Flights Updated Avge	Individuals count	Individuals Updated Avge
1	2013-07-02	Winter	VP1	0.0	0.00	0.0	0.00
2	2013-07-02	Winter	VP2	0.0	0.00	0.0	0.00
3	2013-07-02	Winter	VP4	0.0	0.00	0.0	0.00
4	2013-07-02	Winter	VP4	0.0	0.00	0.0	0.00
5	2013-07-02	Winter	VP1	0.0	0.00	0.0	0.00
6	2013-07-02	Winter	VP2	0.0	0.00	0.0	0.00
7	2013-07-03	Winter	VP6	0.0	0.00	0.0	0.00
8	2013-07-03	Winter	VP5	0.0	0.00	0.0	0.00
9	2013-07-03	Winter	VP3	0.0	0.00	0.0	0.00
10	2013-07-03	Winter	VP5	0.0	0.00	0.0	0.00
11	2013-07-03	Winter	VP6	1.0	0.09	1.0	0.09
12	2013-07-03	Winter	VP3	0.0	0.08	0.0	0.08
13	2013-07-03	Winter	VP1	0.0	0.08	0.0	0.08
14	2013-07-03	Winter	VP2	0.0	0.07	0.0	0.07
15	2013-07-03	Winter	VP4	0.0	0.07	0.0	0.07
16	2013-07-04	Winter	VP4	0.0	0.06	0.0	0.06
17	2013-07-04	Winter	VP1	0.0	0.06	0.0	0.06
18	2013-07-04	Winter	VP2	0.0	0.06	0.0	0.06
19	2013-07-04	Winter	VP4	0.0	0.05	0.0	0.05
20	2013-07-04	Winter	VP1	0.0	0.05	0.0	0.05
21	2013-07-04	Winter	VP2	0.0	0.05	0.0	0.05
22	2013-07-04	Winter	VP5	0.0	0.05	0.0	0.05
23	2013-07-04	Winter	VP3	0.0	0.04	0.0	0.04
24	2013-07-04	Winter	VP6	1.0	0.08	1.0	0.08
25	2013-07-05	Winter	VP6	1.0	0.12	1.0	0.12
26	2013-07-05	Winter	VP5	0.0	0.12	0.0	0.12
27	2013-07-05	Winter	VP3	0.0	0.11	0.0	0.11
28	2013-07-05	Winter	VP3	0.0	0.11	0.0	0.11
29	2013-07-05	Winter	VP5	1.0	0.14	1.0	0.14
30	2013-07-05	Winter	VP6	0.0	0.13	0.0	0.13
31	2013-07-06	Winter	VP4	0.0	0.13	0.0	0.13
32	2013-07-06	Winter	VP1	0.0	0.13	0.0	0.13
33	2013-07-06	Winter	VP2	0.0	0.12	0.0	0.12
34	2013-07-07	Winter	VP3	0.0	0.12	0.0	0.12

35	2013-07-07	Winter	VP5	0.0	0.11	0.0	0.11
36	2013-07-07	Winter	VP6	3.0	0.19	3.0	0.19
37	2013-10-29	Spring	VP3	0.0	0.00	0.0	0.00
38	2013-10-29	Spring	VP1	0.0	0.00	0.0	0.00
39	2013-10-29	Spring	VP1	0.0	0.00	0.0	0.00
40	2013-10-30	Spring	VP1	0.0	0.00	0.0	0.00
41	2013-10-30	Spring	VP2	0.0	0.00	0.0	0.00
42	2013-10-30	Spring	VP3	0.0	0.00	0.0	0.00
43	2013-10-30	Spring	VP1	0.0	0.00	0.0	0.00
44	2013-10-30	Spring	VP6	1.0	0.13	1.0	0.13
45	2013-10-30	Spring	VP2	0.0	0.11	0.0	0.11
46	2013-10-30	Spring	VP3	0.0	0.10	0.0	0.10
47	2013-10-30	Spring	VP4	0.0	0.09	0.0	0.09
48	2013-10-31	Spring	VP6	9.0	0.83	14.0	1.25
49	2013-10-31	Spring	VP5	0.0	0.77	0.0	1.15
50	2013-10-31	Spring	VP2	0.0	0.71	0.0	1.07
51	2013-10-31	Spring	VP6	0.0	0.67	0.0	1.00
52	2013-10-31	Spring	VP5	4.0	0.88	4.0	1.19
53	2013-10-31	Spring	VP4	1.0	0.88	1.0	1.18
54	2013-10-31	Spring	VP2	0.0	0.83	0.0	1.11
55	2013-10-31	Spring	VP1	0.0	0.79	0.0	1.05
56	2013-10-31	Spring	VP3	3.0	0.90	3.0	1.15
57	2013-11-01	Spring	VP6	0.0	0.86	0.0	1.10
58	2013-11-01	Spring	VP5	0.0	0.82	0.0	1.05
59	2013-11-01	Spring	VP1	0.0	0.78	0.0	1.00
60	2013-11-01	Spring	VP3	0.0	0.75	0.0	0.96
61	2013-11-01	Spring	VP4	3.0	0.84	3.0	1.04
62	2013-11-01	Spring	VP4	3.0	0.92	3.0	1.12
63	2013-11-01	Spring	VP5	0.0	0.89	0.0	1.07
64	2013-11-01	Spring	VP6	0.0	0.86	0.0	1.04
65	2013-11-02	Spring	VP4	0.0	0.83	0.0	1.00
66	2013-11-02	Spring	VP5	0.0	0.80	0.0	0.97
67	2013-11-02	Spring	VP3	0.0	0.77	0.0	0.94
68	2013-11-02	Spring	VP2	0.0	0.75	0.0	0.91
69	2013-11-03	Spring	VP4	1.0	0.76	1.0	0.91
70	2013-11-03	Spring	VP2	1.0	0.76	1.0	0.91
71	2013-11-03	Spring	VP5	0.0	0.74	0.0	0.89
72	2013-11-03	Spring	VP6	1.0	0.75	1.0	0.89

73	2014-02-23	Summer	VP1	0.0	0.00	0.0	0.00
74	2014-02-23	Summer	VP2	0.0	0.00	0.0	0.00
75	2014-02-23	Summer	VP2	0.0	0.00	0.0	0.00
76	2014-02-23	Summer	VP1	0.0	0.00	0.0	0.00
77	2014-02-24	Summer	VP1	0.0	0.00	0.0	0.00
78	2014-02-24	Summer	VP2	0.0	0.00	0.0	0.00
79	2014-02-24	Summer	VP1	0.0	0.00	0.0	0.00
80	2014-02-24	Summer	VP2	0.0	0.00	0.0	0.00
81	2014-02-26	Summer	VP3	0.0	0.00	0.0	0.00
82	2014-02-26	Summer	VP6	2.0	0.20	2.0	0.20
83	2014-02-26	Summer	VP3	0.0	0.18	0.0	0.18
84	2014-02-26	Summer	VP6	3.0	0.42	4.0	0.50
85	2014-02-27	Summer	VP1	0.0	0.38	0.0	0.46
86	2014-02-27	Summer	VP2	0.0	0.36	0.0	0.43
87	2014-02-27	Summer	VP4	0.0	0.33	0.0	0.40
88	2014-02-27	Summer	VP5	0.0	0.31	0.0	0.38
89	2014-02-27	Summer	VP3	0.0	0.29	0.0	0.35
90	2014-02-27	Summer	VP4	2.0	0.39	2.0	0.44
91	2014-02-27	Summer	VP5	1.0	0.42	1.0	0.47
92	2014-02-27	Summer	VP6	2.0	0.50	2.0	0.55
93	2014-02-28	Summer	VP6	3.0	0.62	3.0	0.67
94	2014-02-28	Summer	VP2	0.0	0.59	0.0	0.64
95	2014-02-28	Summer	VP1	0.0	0.57	0.0	0.61
96	2014-02-28	Summer	VP3	0.0	0.54	0.0	0.58
97	2014-02-28	Summer	VP3	0.0	0.52	0.0	0.56
98	2014-02-28	Summer	VP6	0.0	0.50	0.0	0.54
99	2014-02-28	Summer	VP4	1.0	0.52	1.0	0.56
100	2014-02-28	Summer	VP5	0.0	0.50	0.0	0.54
101	2014-02-28	Summer	VP5	1.0	0.52	1.0	0.55
102	2014-02-28	Summer	VP4	0.0	0.50	0.0	0.53
103	2014-03-02	Summer	VP5	0.0	0.48	0.0	0.52
104	2014-03-02	Summer	VP6	0.0	0.47	0.0	0.50
105	2014-03-02	Summer	VP3	1.0	0.48	1.0	0.52
106	2014-03-03	Summer	VP4	1.0	0.50	1.0	0.53
107	2014-03-04	Summer	VP4	1.0	0.51	1.0	0.54
108	2014-03-04	Summer	VP5	2.0	0.56	2.0	0.58
109	2014-04-20	Autumn	VP3	0.0	0.00	0.0	0.00
110	2014-04-20	Autumn	VP6	0.0	0.00	0.0	0.00
111	2014-04-20	Autumn	VP3	0.0	0.00	0.0	0.00

112	2014-04-20	Autumn	VP6	0.0	0.00	0.0	0.00
113	2014-04-21	Autumn	VP5	1.0	0.20	1.0	0.20
114	2014-04-21	Autumn	VP6	0.0	0.17	0.0	0.17
115	2014-04-21	Autumn	VP2	0.0	0.14	0.0	0.14
116	2014-04-21	Autumn	VP4	0.0	0.13	0.0	0.13
117	2014-04-21	Autumn	VP5	0.0	0.11	0.0	0.11
118	2014-04-21	Autumn	VP6	2.0	0.30	2.0	0.30
119	2014-04-21	Autumn	VP2	0.0	0.27	0.0	0.27
120	2014-04-21	Autumn	VP4	0.0	0.25	0.0	0.25
121	2014-04-22	Autumn	VP1	0.0	0.23	0.0	0.23
122	2014-04-22	Autumn	VP1	0.0	0.21	0.0	0.21
123	2014-04-22	Autumn	VP2	0.0	0.20	0.0	0.20
124	2014-04-22	Autumn	VP4	0.0	0.19	0.0	0.19
125	2014-04-22	Autumn	VP2	0.0	0.18	0.0	0.18
126	2014-04-22	Autumn	VP4	0.0	0.17	0.0	0.17
127	2014-04-23	Autumn	VP4	1.0	0.21	1.0	0.21
128	2014-04-23	Autumn	VP2	0.0	0.20	0.0	0.20
129	2014-04-23	Autumn	VP1	0.0	0.19	0.0	0.19
130	2014-04-23	Autumn	VP5	4.0	0.36	5.0	0.41
131	2014-04-23	Autumn	VP5	0.0	0.35	0.0	0.39
132	2014-04-23	Autumn	VP1	0.0	0.33	0.0	0.38
133	2014-04-24	Autumn	VP4	2.0	0.40	2.0	0.44
134	2014-04-24	Autumn	VP1	0.0	0.38	0.0	0.42
135	2014-04-24	Autumn	VP2	0.0	0.37	0.0	0.41
136	2014-04-25	Autumn	VP1	0.0	0.36	0.0	0.39
137	2014-04-26	Autumn	VP6	1.0	0.38	2.0	0.45
138	2014-04-26	Autumn	VP5	0.0	0.37	0.0	0.43
139	2014-04-26	Autumn	VP3	0.0	0.35	0.0	0.42
140	2014-04-26	Autumn	VP3	0.0	0.34	0.0	0.41
141	2014-04-27	Autumn	VP6	2.0	0.39	2.0	0.45
142	2014-04-27	Autumn	VP3	0.0	0.38	0.0	0.44
143	2014-04-27	Autumn	VP3	0.0	0.37	0.0	0.43
144	2014-04-28	Autumn	VP5	0.0	0.36	0.0	0.42

Table I: ***Terrestrial Birds*: Flights and Individuals for priority species per watch period and by vantage point over time with updated averages per consecutive watch period.**

Watch Number	Date	Season	VP	Flights count	Flights Updated Avge	Individuals count	Individuals Updated Avge
1	2013-07-02	Winter	VP1	0.0	0.00	0.0	0.00
2	2013-07-02	Winter	VP2	0.0	0.00	0.0	0.00
3	2013-07-02	Winter	VP4	0.0	0.00	0.0	0.00
4	2013-07-02	Winter	VP4	1.0	0.25	1.0	0.25
5	2013-07-02	Winter	VP1	0.0	0.20	0.0	0.20
6	2013-07-02	Winter	VP2	0.0	0.17	0.0	0.17
7	2013-07-03	Winter	VP6	6.0	1.00	24.0	3.57
8	2013-07-03	Winter	VP5	1.0	1.00	2.0	3.38
9	2013-07-03	Winter	VP3	0.0	0.89	0.0	3.00
10	2013-07-03	Winter	VP5	0.0	0.80	0.0	2.70
11	2013-07-03	Winter	VP6	2.0	0.91	8.0	3.18
12	2013-07-03	Winter	VP3	0.0	0.83	0.0	2.92
13	2013-07-03	Winter	VP1	1.0	0.85	4.0	3.00
14	2013-07-03	Winter	VP2	0.0	0.79	0.0	2.79
15	2013-07-03	Winter	VP4	0.0	0.73	0.0	2.60
16	2013-07-04	Winter	VP4	0.0	0.69	0.0	2.44
17	2013-07-04	Winter	VP1	0.0	0.65	0.0	2.29
18	2013-07-04	Winter	VP2	1.0	0.67	1.0	2.22
19	2013-07-04	Winter	VP4	0.0	0.63	0.0	2.11
20	2013-07-04	Winter	VP1	0.0	0.60	0.0	2.00
21	2013-07-04	Winter	VP2	0.0	0.57	0.0	1.90
22	2013-07-04	Winter	VP5	0.0	0.55	0.0	1.82
23	2013-07-04	Winter	VP3	0.0	0.52	0.0	1.74
24	2013-07-04	Winter	VP6	0.0	0.50	0.0	1.67
25	2013-07-05	Winter	VP6	8.0	0.80	28.0	2.72
26	2013-07-05	Winter	VP5	2.0	0.85	3.0	2.73
27	2013-07-05	Winter	VP3	1.0	0.85	1.0	2.67
28	2013-07-05	Winter	VP3	0.0	0.82	0.0	2.57
29	2013-07-05	Winter	VP5	1.0	0.83	1.0	2.52
30	2013-07-05	Winter	VP6	3.0	0.90	14.0	2.90
31	2013-07-06	Winter	VP4	0.0	0.87	0.0	2.81
32	2013-07-06	Winter	VP1	1.0	0.88	2.0	2.78
33	2013-07-06	Winter	VP2	0.0	0.85	0.0	2.70
34	2013-07-07	Winter	VP3	0.0	0.82	0.0	2.62

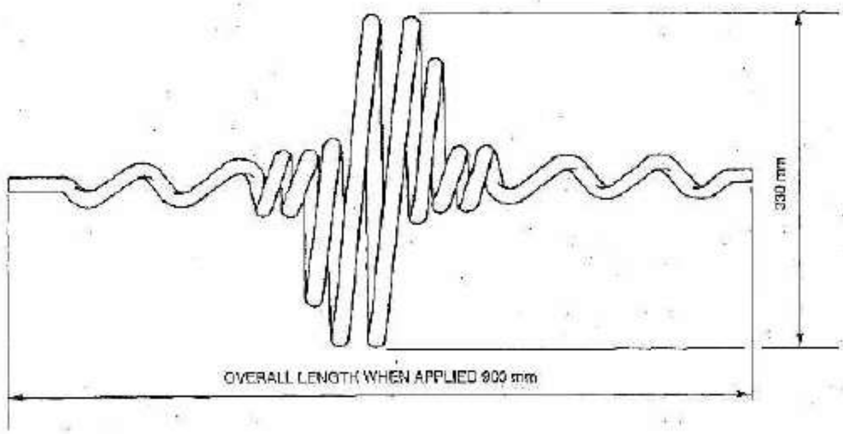
35	2013-07-07	Winter	VP5	0.0	0.80	0.0	2.54
36	2013-07-07	Winter	VP6	0.0	0.78	0.0	2.47
37	2013-10-29	Spring	VP3	1.0	1.00	2.0	2.00
38	2013-10-29	Spring	VP1	0.0	0.50	0.0	1.00
39	2013-10-29	Spring	VP1	1.0	0.67	1.0	1.00
40	2013-10-30	Spring	VP1	0.0	0.50	0.0	0.75
41	2013-10-30	Spring	VP2	0.0	0.40	0.0	0.60
42	2013-10-30	Spring	VP3	1.0	0.50	1.0	0.67
43	2013-10-30	Spring	VP1	1.0	0.57	1.0	0.71
44	2013-10-30	Spring	VP6	0.0	0.50	0.0	0.63
45	2013-10-30	Spring	VP2	0.0	0.44	0.0	0.56
46	2013-10-30	Spring	VP3	0.0	0.40	0.0	0.50
47	2013-10-30	Spring	VP4	0.0	0.36	0.0	0.45
48	2013-10-31	Spring	VP6	7.0	0.92	34.0	3.25
49	2013-10-31	Spring	VP5	0.0	0.85	0.0	3.00
50	2013-10-31	Spring	VP2	0.0	0.79	0.0	2.79
51	2013-10-31	Spring	VP6	0.0	0.73	0.0	2.60
52	2013-10-31	Spring	VP5	0.0	0.69	0.0	2.44
53	2013-10-31	Spring	VP4	0.0	0.65	0.0	2.29
54	2013-10-31	Spring	VP2	0.0	0.61	0.0	2.17
55	2013-10-31	Spring	VP1	0.0	0.58	0.0	2.05
56	2013-10-31	Spring	VP3	0.0	0.55	0.0	1.95
57	2013-11-01	Spring	VP6	8.0	0.90	19.0	2.76
58	2013-11-01	Spring	VP5	2.0	0.95	3.0	2.77
59	2013-11-01	Spring	VP1	0.0	0.91	0.0	2.65
60	2013-11-01	Spring	VP3	0.0	0.88	0.0	2.54
61	2013-11-01	Spring	VP4	0.0	0.84	0.0	2.44
62	2013-11-01	Spring	VP4	0.0	0.81	0.0	2.35
63	2013-11-01	Spring	VP5	0.0	0.78	0.0	2.26
64	2013-11-01	Spring	VP6	0.0	0.75	0.0	2.18
65	2013-11-02	Spring	VP4	0.0	0.72	0.0	2.10
66	2013-11-02	Spring	VP5	0.0	0.70	0.0	2.03
67	2013-11-02	Spring	VP3	0.0	0.68	0.0	1.97
68	2013-11-02	Spring	VP2	0.0	0.66	0.0	1.91
69	2013-11-03	Spring	VP4	0.0	0.64	0.0	1.85
70	2013-11-03	Spring	VP2	0.0	0.62	0.0	1.79
71	2013-11-03	Spring	VP5	0.0	0.60	0.0	1.74
72	2013-11-03	Spring	VP6	1.0	0.61	2.0	1.75

73	2014-02-23	Summer	VP1	0.0	0.00	0.0	0.00
74	2014-02-23	Summer	VP2	0.0	0.00	0.0	0.00
75	2014-02-23	Summer	VP2	0.0	0.00	0.0	0.00
76	2014-02-23	Summer	VP1	0.0	0.00	0.0	0.00
77	2014-02-24	Summer	VP1	0.0	0.00	0.0	0.00
78	2014-02-24	Summer	VP2	0.0	0.00	0.0	0.00
79	2014-02-24	Summer	VP1	0.0	0.00	0.0	0.00
80	2014-02-24	Summer	VP2	0.0	0.00	0.0	0.00
81	2014-02-26	Summer	VP3	0.0	0.00	0.0	0.00
82	2014-02-26	Summer	VP6	0.0	0.00	0.0	0.00
83	2014-02-26	Summer	VP3	1.0	0.09	1.0	0.09
84	2014-02-26	Summer	VP6	0.0	0.08	0.0	0.08
85	2014-02-27	Summer	VP1	0.0	0.08	0.0	0.08
86	2014-02-27	Summer	VP2	0.0	0.07	0.0	0.07
87	2014-02-27	Summer	VP4	0.0	0.07	0.0	0.07
88	2014-02-27	Summer	VP5	0.0	0.06	0.0	0.06
89	2014-02-27	Summer	VP3	1.0	0.12	1.0	0.12
90	2014-02-27	Summer	VP4	0.0	0.11	0.0	0.11
91	2014-02-27	Summer	VP5	0.0	0.11	0.0	0.11
92	2014-02-27	Summer	VP6	1.0	0.15	2.0	0.20
93	2014-02-28	Summer	VP6	0.0	0.14	0.0	0.19
94	2014-02-28	Summer	VP2	0.0	0.14	0.0	0.18
95	2014-02-28	Summer	VP1	1.0	0.17	2.0	0.26
96	2014-02-28	Summer	VP3	0.0	0.17	0.0	0.25
97	2014-02-28	Summer	VP3	0.0	0.16	0.0	0.24
98	2014-02-28	Summer	VP6	0.0	0.15	0.0	0.23
99	2014-02-28	Summer	VP4	1.0	0.19	1.0	0.26
100	2014-02-28	Summer	VP5	0.0	0.18	0.0	0.25
101	2014-02-28	Summer	VP5	0.0	0.17	0.0	0.24
102	2014-02-28	Summer	VP4	1.0	0.20	1.0	0.27
103	2014-03-02	Summer	VP5	6.0	0.39	7.0	0.48
104	2014-03-02	Summer	VP6	2.0	0.44	6.0	0.66
105	2014-03-02	Summer	VP3	0.0	0.42	0.0	0.64
106	2014-03-03	Summer	VP4	2.0	0.47	2.0	0.68
107	2014-03-04	Summer	VP4	2.0	0.51	2.0	0.71
108	2014-03-04	Summer	VP5	2.0	0.56	2.0	0.75
109	2014-04-20	Autumn	VP3	0.0	0.00	0.0	0.00
110	2014-04-20	Autumn	VP6	0.0	0.00	0.0	0.00
111	2014-04-20	Autumn	VP3	0.0	0.00	0.0	0.00

112	2014-04-20	Autumn	VP6	8.0	2.00	16.0	4.00
113	2014-04-21	Autumn	VP5	0.0	1.60	0.0	3.20
114	2014-04-21	Autumn	VP6	0.0	1.33	0.0	2.67
115	2014-04-21	Autumn	VP2	0.0	1.14	0.0	2.29
116	2014-04-21	Autumn	VP4	0.0	1.00	0.0	2.00
117	2014-04-21	Autumn	VP5	1.0	1.00	1.0	1.89
118	2014-04-21	Autumn	VP6	1.0	1.00	2.0	1.90
119	2014-04-21	Autumn	VP2	0.0	0.91	0.0	1.73
120	2014-04-21	Autumn	VP4	0.0	0.83	0.0	1.58
121	2014-04-22	Autumn	VP1	0.0	0.77	0.0	1.46
122	2014-04-22	Autumn	VP1	0.0	0.71	0.0	1.36
123	2014-04-22	Autumn	VP2	0.0	0.67	0.0	1.27
124	2014-04-22	Autumn	VP4	1.0	0.69	2.0	1.31
125	2014-04-22	Autumn	VP2	0.0	0.65	0.0	1.24
126	2014-04-22	Autumn	VP4	1.0	0.67	2.0	1.28
127	2014-04-23	Autumn	VP4	0.0	0.63	0.0	1.21
128	2014-04-23	Autumn	VP2	1.0	0.65	1.0	1.20
129	2014-04-23	Autumn	VP1	0.0	0.62	0.0	1.14
130	2014-04-23	Autumn	VP5	0.0	0.59	0.0	1.09
131	2014-04-23	Autumn	VP5	2.0	0.65	4.0	1.22
132	2014-04-23	Autumn	VP1	0.0	0.63	0.0	1.17
133	2014-04-24	Autumn	VP4	1.0	0.64	7.0	1.40
134	2014-04-24	Autumn	VP1	1.0	0.65	3.0	1.46
135	2014-04-24	Autumn	VP2	1.0	0.67	2.0	1.48
136	2014-04-25	Autumn	VP1	0.0	0.64	0.0	1.43
137	2014-04-26	Autumn	VP6	3.0	0.72	8.0	1.66
138	2014-04-26	Autumn	VP5	2.0	0.77	7.0	1.83
139	2014-04-26	Autumn	VP3	3.0	0.84	3.0	1.87
140	2014-04-26	Autumn	VP3	1.0	0.84	3.0	1.91
141	2014-04-27	Autumn	VP6	2.0	0.88	14.0	2.27
142	2014-04-27	Autumn	VP3	1.0	0.88	1.0	2.24
143	2014-04-27	Autumn	VP3	0.0	0.86	0.0	2.17
144	2014-04-28	Autumn	VP5	2.0	0.89	2.0	2.17

APPENDIX D: BIRD FLIGHT DIVERTER

Double Loop Bird Flight Diverter



Material Used: Manufactured from rigid solid high impact polyvinyl chloride, possessing excellent chemical and strength properties and which will retain good physical characteristics within the range of extreme temperatures. Outdoor aging tests indicate that the material does not deteriorate in function or appearance from the effects of severe weather conditions. Industrial fumes and salt water cannot seriously degrade the properties of rigid PVC.

Colour: White or Black

Lay Direction: Bird Flight Diverters are supplied right hand lay for both right hand and left hand lay bare conductors and insulated cables.

CATALOGUE NO.	CONDUCTOR/ E/WIRE DIA. RANGE
BFD 0914/LD2*	9 mm – 14 mm

*Add B or W to denote colour

INDEX

E - 4

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