

# Exploration of spatial parameters of Black-Footed Albatross (*Phoebastria nigripes*), BFAL, foraging during chick rearing months, through multivariate statistics

The overall goal was to describe relationships within and between individual BFAL.

- Difference between years was compared to see if there was significance between them; if not, the two years were to be combined for NMDS analysis. NMDS was used due to lack of normality and no presence absence data with species.
- MRPPs were used to test differences between years and sex.

It was predicted that there would be a significant correlation between track duration and distance traveled. Also, there may be a difference between male and female distances and durations; males being able to travel farther/ longer due to their slightly larger body morphometrics.

# Dataset Description

➤ Data file: [Raw\\_Averages.wk1](#) & [Second\\_Matrix.wk1](#)

197	Samples						197	Samples	
5	Variables						2	Variables	
	Q	Q	Q	Q	Q			C	C
Trip_id	tracks.duration.hrs	mean_latitude	mean_longitude360	mean_dist2col	mid_julian	Trip_id	Sex	Year	
10.01	5.304167	28.34891	181.6473	7.647226	54.5	10.01	1	2012	

- 197 samples and 7 variables
- Samples are GPS tracks of 18 BFAL from Kure Atoll
- Variables:
  - Track Duration: hours
  - Mean Latitude
  - Mean Longitude
  - Mean Distance to colony: km
  - Time: Mid-Julian Date (2/22 – 5/14/2012 & 2/21 – 5/6/2013)
  - Sex: 0-Male 1-Female
  - Year: 2012 & 2013

# Dataset Processing

## ➤ Outliers:

- All Outliers were kept
- 14 tracks were outliers before relativizing and 5 tracks were seen as outliers after

BFAL\_OA\_RelSor

RANK	ENTITY NAME	AVERAGE DISTANCE	STANDARD DEVIATIONS
1	10.02	0.48562	2.17786
2	5.02	0.48481	2.16590
3	5.03	0.48164	2.11961
4	2.13	0.47983	2.09321
5	11.21	0.47714	2.05383

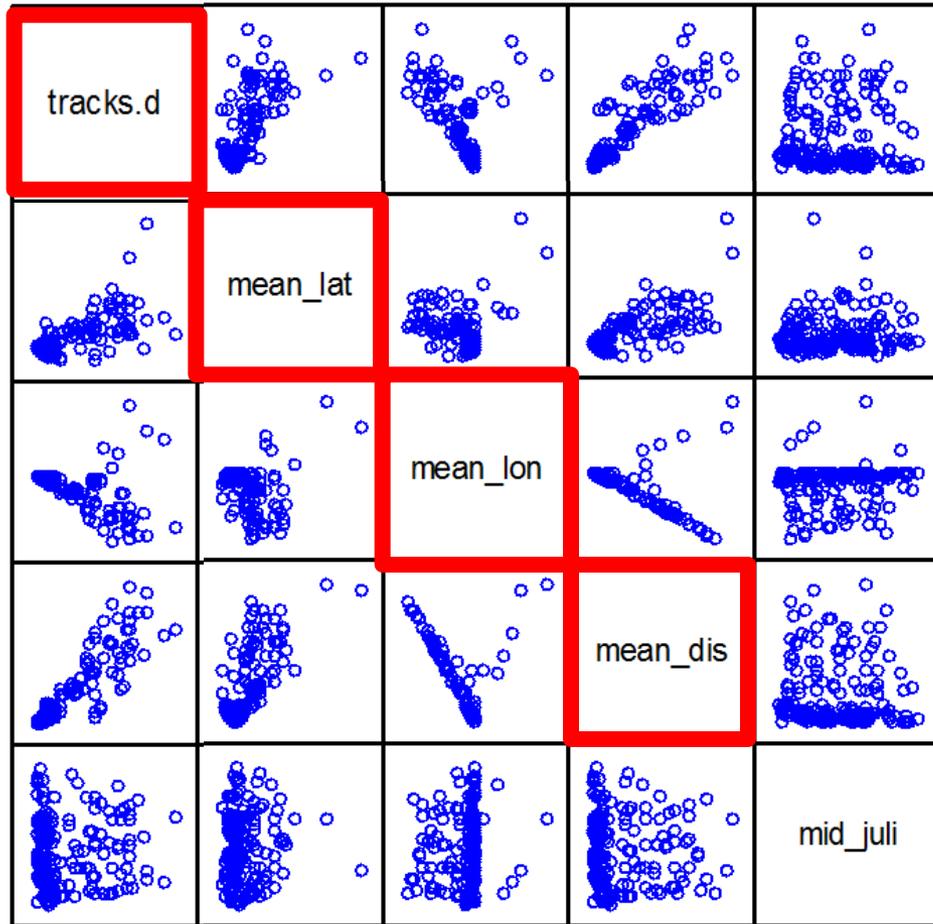
- Temperature variable was previously removed due to assumptions of false readings

## ➤ Relativized using General Relativization with $p=1$

## ➤ Final Data set included:

- 197 Samples
- 7 Environmental Variables

# Dataset Exploration: Cross-correlations



➤ Since Mid-Julian Date did not have significant cross-correlations with the other four variables, there were no temporal changes found

	Mean_dist2col	Tracks.duration.hrs	Mean_latitude	Mean_longitude360
Mean_dist2col	1	0.913**	0.749**	-0.608**
Tracks.duration.hrs	p<0.000	1	0.669**	-0.551**

# Dataset Analysis: NMDS

BFAL\_NMS\_RelSor

Ordination of Samples in Variable space.

197 Samples

5 Variable

The following options were selected:

## ANALYSIS OPTIONS

1. REL.SOREN. = Distance measure
2. 5 = Number of axes (max. = 6)
3. 250 = Maximum number of iterations
4. RANDOM = Starting coordinates (random or from file)
5. 1 = Reduction in dimensionality at each cycle
6. NO PENALTY = Tie handling (Strategy 1 does not penalize ties with unequal ordination distance, while strategy 2 does penalize.)
7. 0.20 = Step length (rate of movement toward minimum stress)
8. USE TIME = Random number seeds (use time vs. user-supplied)
9. 1000 = Number of runs with real data
10. 249 = Number of runs with randomized data
11. NO = Autopilot
12. 0.000001 = Stability criterion, standard deviations in stress over last 15 iterations.

## OUTPUT OPTIONS

14. YES = Write distance matrix?
15. NO = Write starting coordinates?
16. NO = List stress, etc. for each iteration?
17. YES = Plot stress vs. iteration?
18. NO = Plot distance vs. dissimilarity?
19. YES = Write final configuration?
20. UNROTATED = Write varimax-rotated, principal axes, or unrotated scores for graph?
21. NO = Write run log?
22. YES = Write weighted-average scores for Variable?

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5493 = Seed for random number generator.

# Results Interpretation: Stress

**Criterion 1: Decline in Stress with added axis at least 5**

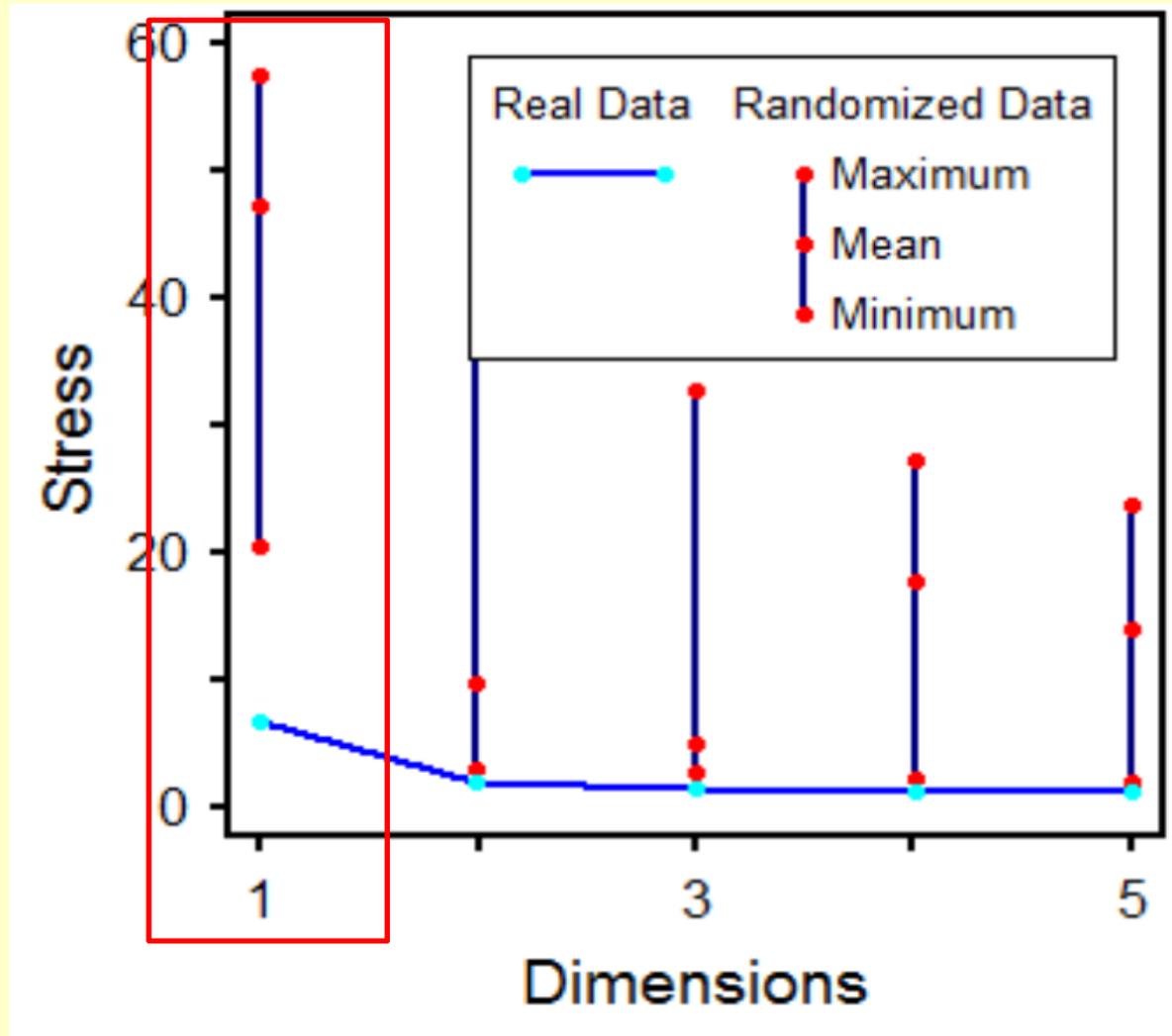
**Criterion 2: P value < 0.05**

Table 4. STRESS IN RELATION TO DIMENSIONALITY (Number of Axes)

Axes	Stress in real data 1000 run(s)			Stress in randomized data Monte Carlo test, 249 runs			p
	Minimum	Mean	Maximum	Minimum	Mean	Maximum	
1	6.630	37.574	57.456	20.606	47.371	57.441	0.0040
2	1.978	5.452	41.662	3.125	9.629	41.655	0.0040
3	1.530	2.643	32.705	2.664	4.887	32.705	0.0040
4	1.306	14.567	27.196	2.346	17.737	27.194	0.0040
5	1.210	12.766	23.697	1.983	14.095	23.697	0.0040

p = proportion of randomized runs with stress < or = observed stress  
i.e.,  $p = (1 + \text{no. permutations} \leq \text{observed}) / (1 + \text{no. permutations})$

# Results Interpretation: NMDS Screeplot



# Results Interpretation: Variance & MRPP

## ➤ Coefficient of Determination (% of Variance):

```
BFAL_NMS_%Variance_RelSor  
  
R Squared  
Axis    Increment    Cumulative  
1        .987           .987
```

## ➤ MRPPs showed no significance between sex ( $p < 0.4$ ) and significance between years ( $p < 0.03$ )

MRPP\_Sex

Test statistic:  $T = 0.24673641$

Chance-corrected within-group agreement,  $A = -0.00107777$

$A < 0$  with more heterogeneity within groups than expected by chance

Probability of a smaller or equal delta,  $p = 0.43305056$

MRPP\_Year

Test statistic:  $T = -2.5082864$

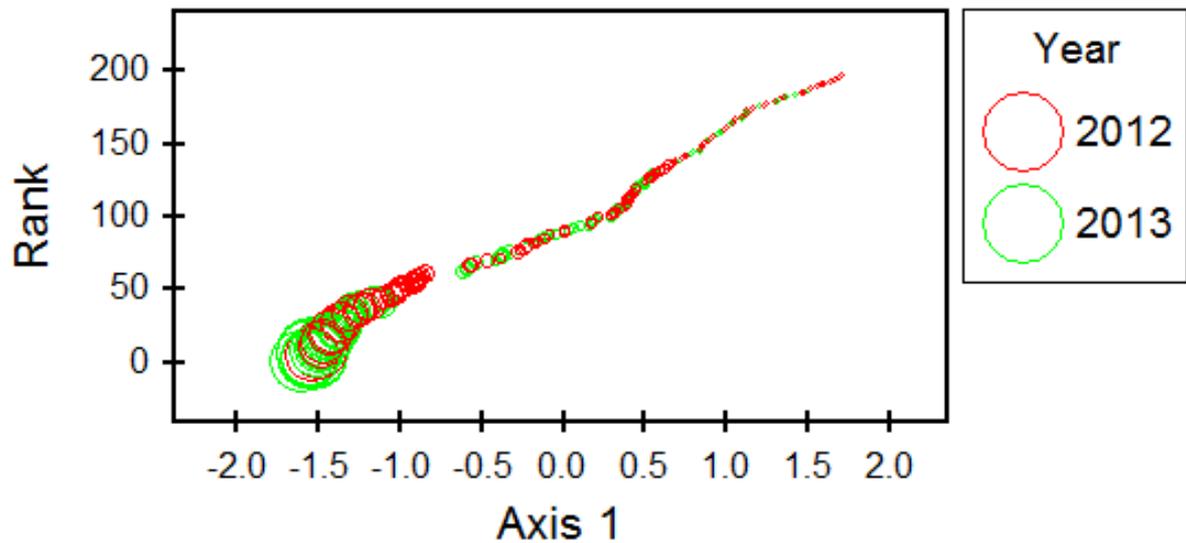
Chance-corrected within-group agreement,  $A = 0.01096010$

$A < 0$  with more heterogeneity within groups than expected by chance

Probability of a smaller or equal delta,  $p = 0.03242592$

# Results Interpretation: Correlations

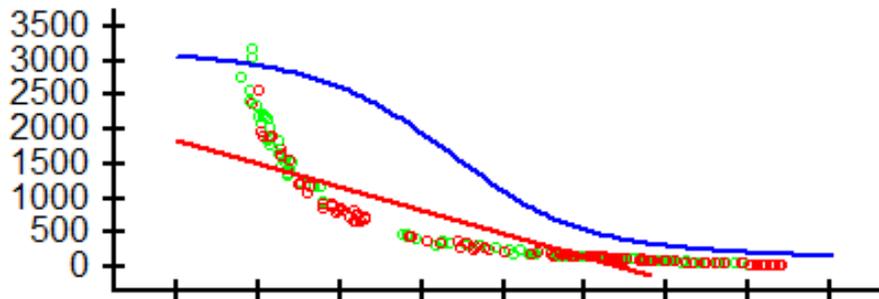
- BFAL from 2013 went farther distances than in 2012



Mean Distance

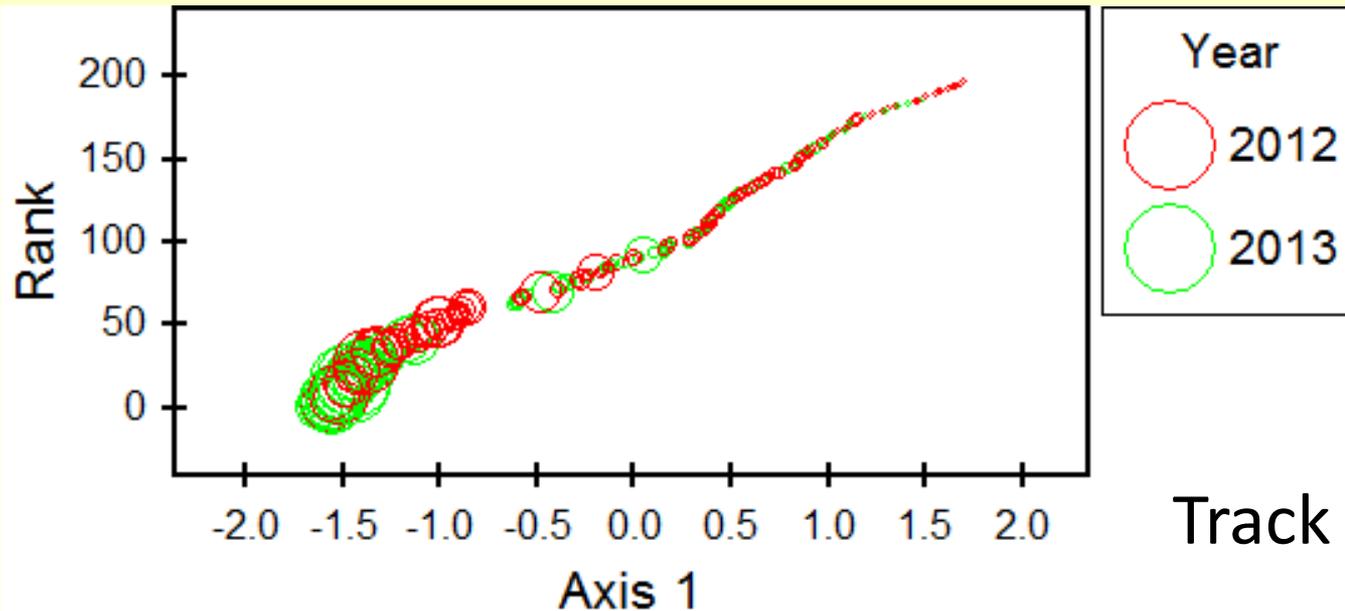
Axis 1

$$r = -.848 \quad \tau = -.961$$



# Results Interpretation: Correlations

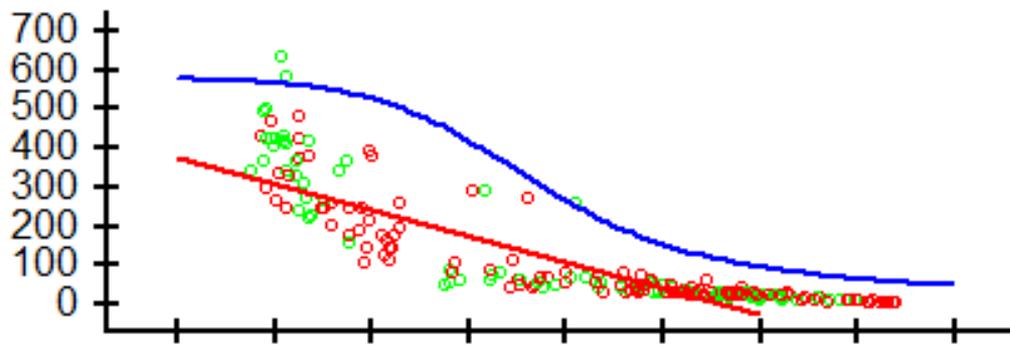
- BFAL from 2013 took longer trips than in 2012



Track Duration

Axis 1

$$r = -.846 \quad \tau = -.826$$



# Discussion

- It was predicted that there would be a significant correlation between track duration and distance traveled.
  - This correlation was shown to have the strongest relationship ( $r=0.913$ )
- Unfortunately, after yielding insignificance of sex from the MRPP, the sexual dimorphism of the birds had no influence on how the birds travels
- The NMDS and MRPP helped to show the relationships between the environmental variables along with show how cross-correlated all of the variables were due to 1 significant axis

## Next Steps

- Re-analysis: Run the same analyses but using the range values instead of the mean values

# Questions?

