

Raine Island revisited:

catastrophic declines in seabird abundances perhaps not so catastrophic after all

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Agricultural Sciences

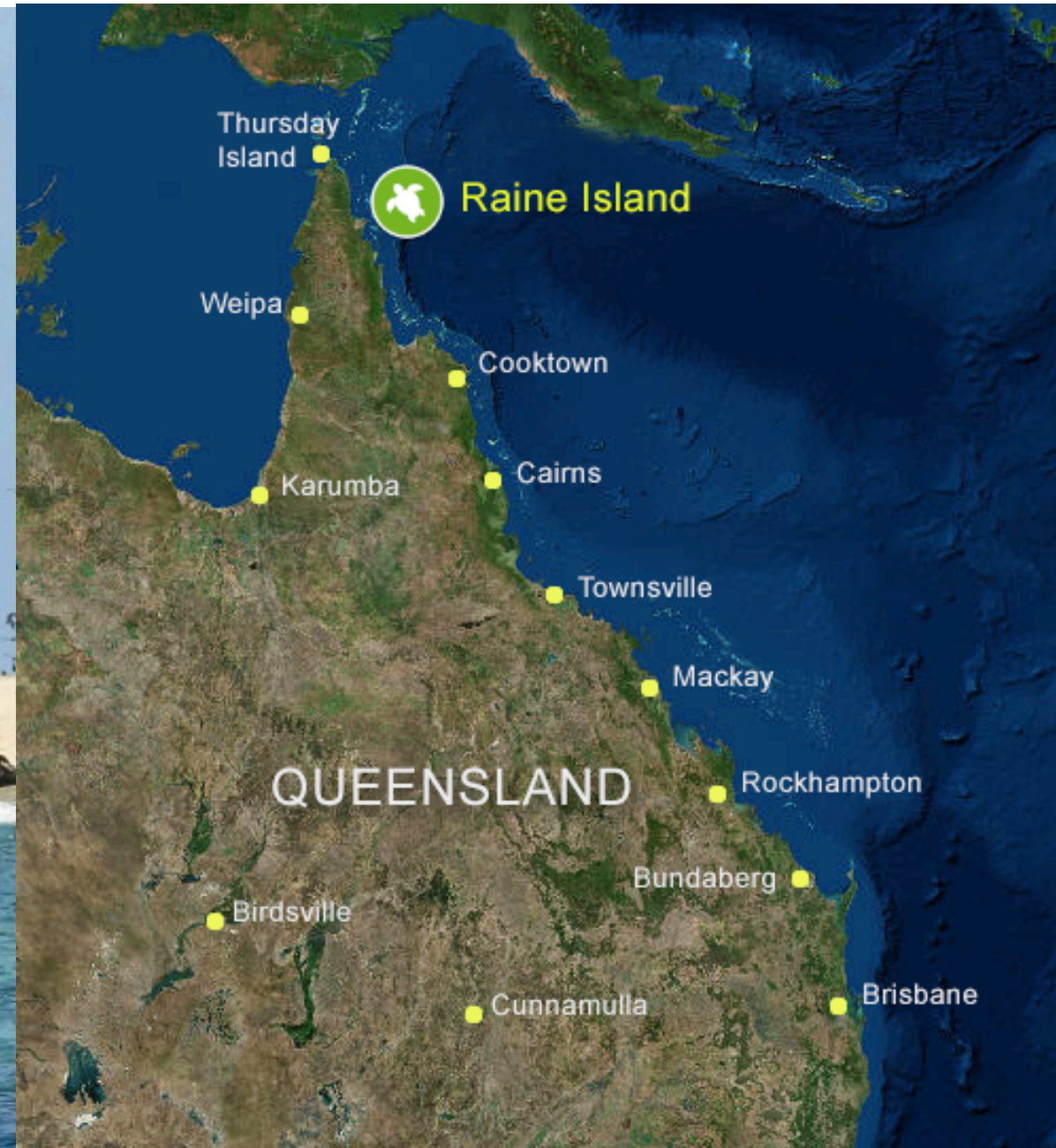


Queensland Government

Department of National Parks, Sport and Racing

All photos from Wikimedia and Raine Island Recovery Project

Raine Island: most important seabird rookery on GBR



Batianoff & Cornelius 2005

Birds of Raine Island: population trends, breeding behaviour and nesting habitats.
Proceedings of the Royal Society of Queensland, **112**: 1-29.

BIRDS OF RAINE ISLAND: POPULATION TRENDS, BREEDING BEHAVIOUR AND NESTING HABITATS

GEORGE N. BATIANOFF AND N.J. (JOHN) CORNELIUS

Batianoff, G.N. & Cornelius, N.J. 2005 05 23: Birds of Raine Island: population trends breeding behaviour and nesting habitats. *Proceedings of the Royal Society of Queensland*, **112**: 1-29. Brisbane. ISSN 0080-469X.

The avifauna recorded from Raine Island between 1843 and 2003 comprises 84 species. Of the 16 species recorded as breeding on Raine Island, five are seabird species considered to be uncommon and/or rare in Queensland i.e. Herald Petrel, Red-tailed Tropicbird, Red-footed Booby, and Great and Lesser Frigatebirds. The Red-tailed Tropicbird's conservation status in Queensland is Vulnerable, whilst the Herald Petrel is listed as Critically Endangered in Australia. The waterbird species breeding on the island are the Nankeen Night Heron and the Buff-banded Rail. The terrestrial ecological factors that affect the birds breeding on Raine Island are examined. Annual seabird population counts taken between 1979-1993 and 1994-2003 are reported. Comparisons of bird populations between the two periods suggest population decline in 13 of the 16 species over the last 24 years. The combined averages for all 16 species indicate a total population reduction of the rookery by 16,347 birds, or 69.7%. Five species with >60% reductions in the mean population estimates are: Red-footed Booby (67.9%), Lesser Frigatebird (67.6%), Bridled Tern (69.1%), Sooty Tern (84.4%) and Common Noddy (95.5%). There is no evidence of significant human disturbance, no habitat loss and/or deterioration of nesting habitat conditions on the island over the period in which the population has declined. □ *Tropical seabirds and habitats, population decline, breeding, nesting and roosting behaviour.*

George N Batianoff Queensland Herbarium (EPA) Brisbane Botanical Gardens, Toowong 4067; N. John Cornelius Queensland Parks and Wildlife Service, Cairns 4870; 16 July 2004, revised 11 January 2005.

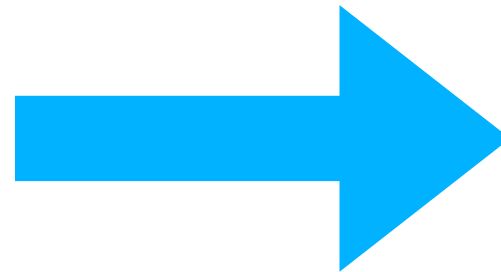
Batianoff & Cornelius 2005

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Period 1

22 surveys

1979 - 1993



Period 2

22 surveys

1994 - 2003

They compared the average population abundance from period 1 to period 2 for evidence of **decline**, **increase** or **stability**

Species	Change in abundance period 1 to period 2			Trend
Common Noddy	11693	→	526	-95.5%
Red-footed Booby	467	→	150	-67.9%
Lesser Frigatebird	1851	→	599	-67.6%
Brown Booby	4435	→	2642	-40.4%
Red-tailed Tropicbird	104	→	64	-38.5%
Masked Booby	1457	→	1065	-26.9%

Dramatic declines!

Species

Change in abundance
period 1 to period 2

Trend

Red-footed Booby

467 → 150

-67.9%

What exactly does this
change mean and how
should we interpret it?

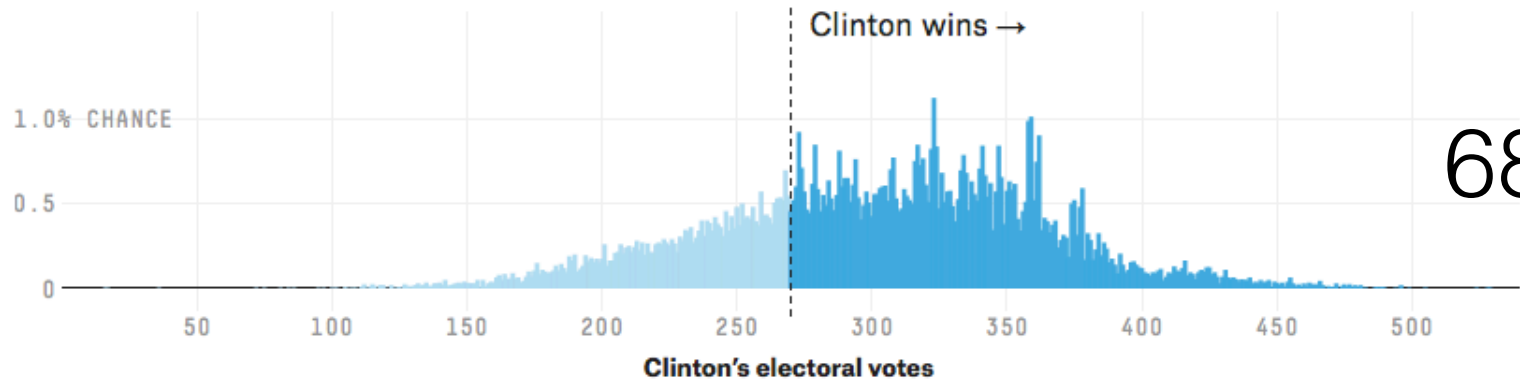
How confident can we
be that a dramatic
decline has occurred?



photo: Gregg Yan (wikimedia)

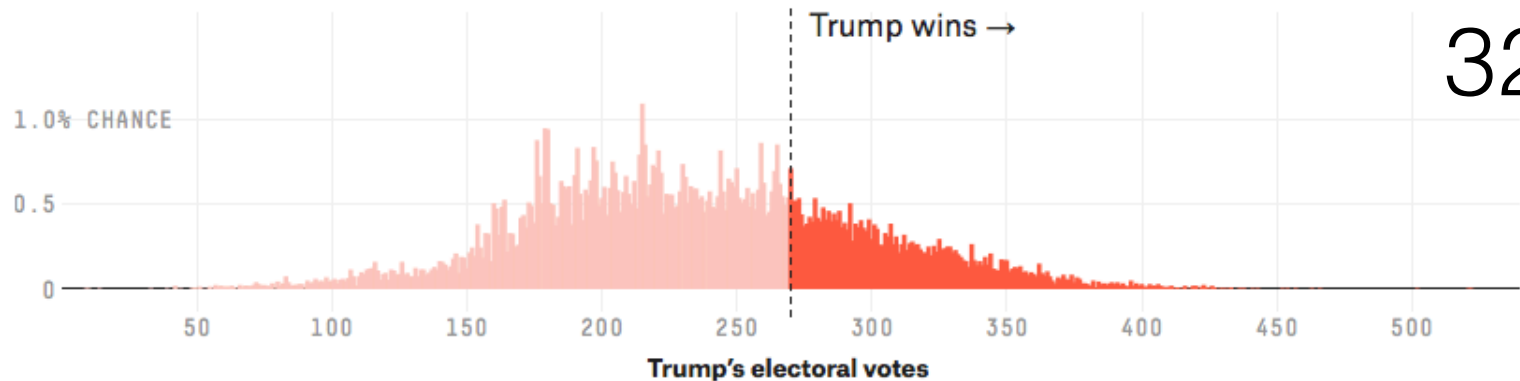
Princeton election consortium

<1% chance that Trump could win



68% Probability

Five thirty eight



32% Probability

Lies, damned lies and statistics

What are the limitations and assumptions of the model and data and how robust are the results to these assumptions?

Batianoff & Cornelius

“was **collated from all available data...**
includes free-flying, breeding and non-
breeding birds,

and is **inclusive of all seasons**”

Species	Change in abundance period 1 to period 2		Trend
Red-footed Booby	467	→ 150	-67.9%
.....			
all data	344	→ 161	-53.2%
removed incomplete	383	→ 178	-53.5%
removed duplicates	366	→ 151	-58.7%
removed dodgy counts	447	→ 151	-66.2%

Dramatic declines!

But what are we
interested in?



Usually interested in
changes in the breeding
population

- more meaningful
- more accurate



Species	Change in <u>nesting pairs</u> period 1 to period 2	Trend
all	73 → 85	+16.4%
removed incomplete removed duplicates	74 → 81	+9.5%
removed dodgy counts	92 → 81	-11.9%



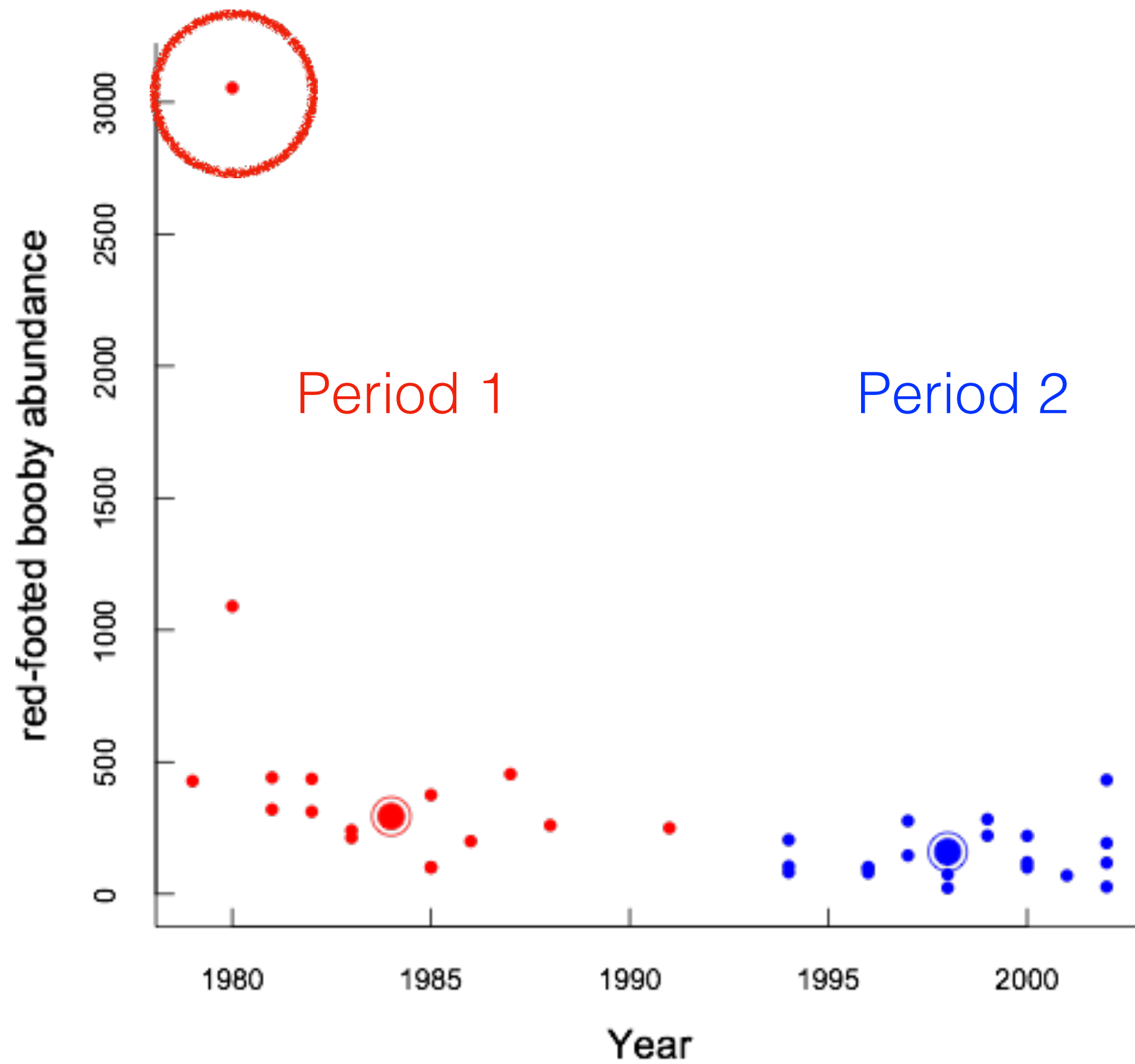
month	year	count	pairs
10	1979	352	76
12	1980	3000	54
6	1980	1000	90
11	1981	280	40
6	1981	400	41
11	1982	374	62
7	1982	276	36
4	1983	200	41
7	1983	200	13
7	1984	200	79
7	1985	300	75
8	1987	303	151
7	1988	100	160
6	1991	NA	250
11	1994	NA	82
12	1994	NA	105
11	1996	56	40
12	1996	46	34
6	1996	40	62
11	1997	186	91
12	1997	86	60
11	1998	NA	23
12	1998	NA	74
11	2000	110	110
7	2000	60	60
11	2002	90	103
2	2002	21	6
6	2002	203	229
10	1994	1	197
11	1999	205	78
12	1999	NA	221
12	2001	NA	44
12	2002	100	57

Period 1

Period 2

month	year	count	pairs	
10	1979	352	76	Period 1
12	1980	3000	54	
6	1980	1000	90	
11	1981	280	40	
6	1981	400	41	
11	1982	374	62	
7	1982	276	36	
4	1983	200	41	
7	1983	200	13	
7	1984	200	79	
7	1985	300	75	
8	1987	303	151	
7	1988	100	160	
6	1991	NA	250	
11	1994	NA	82	Period 2
12	1994	NA	105	
11	1996	56	40	
12	1996	46	34	
6	1996	40	62	
11	1997	186	91	
12	1997	86	60	
11	1998	NA	23	
12	1998	NA	74	
11	2000	110	110	
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Period 1

Period 2

How have we modelled the trends differently?

Extended the data range from 1970 - 2016

Counts of Breeding Pairs only

Only used data where actual counts were attempted

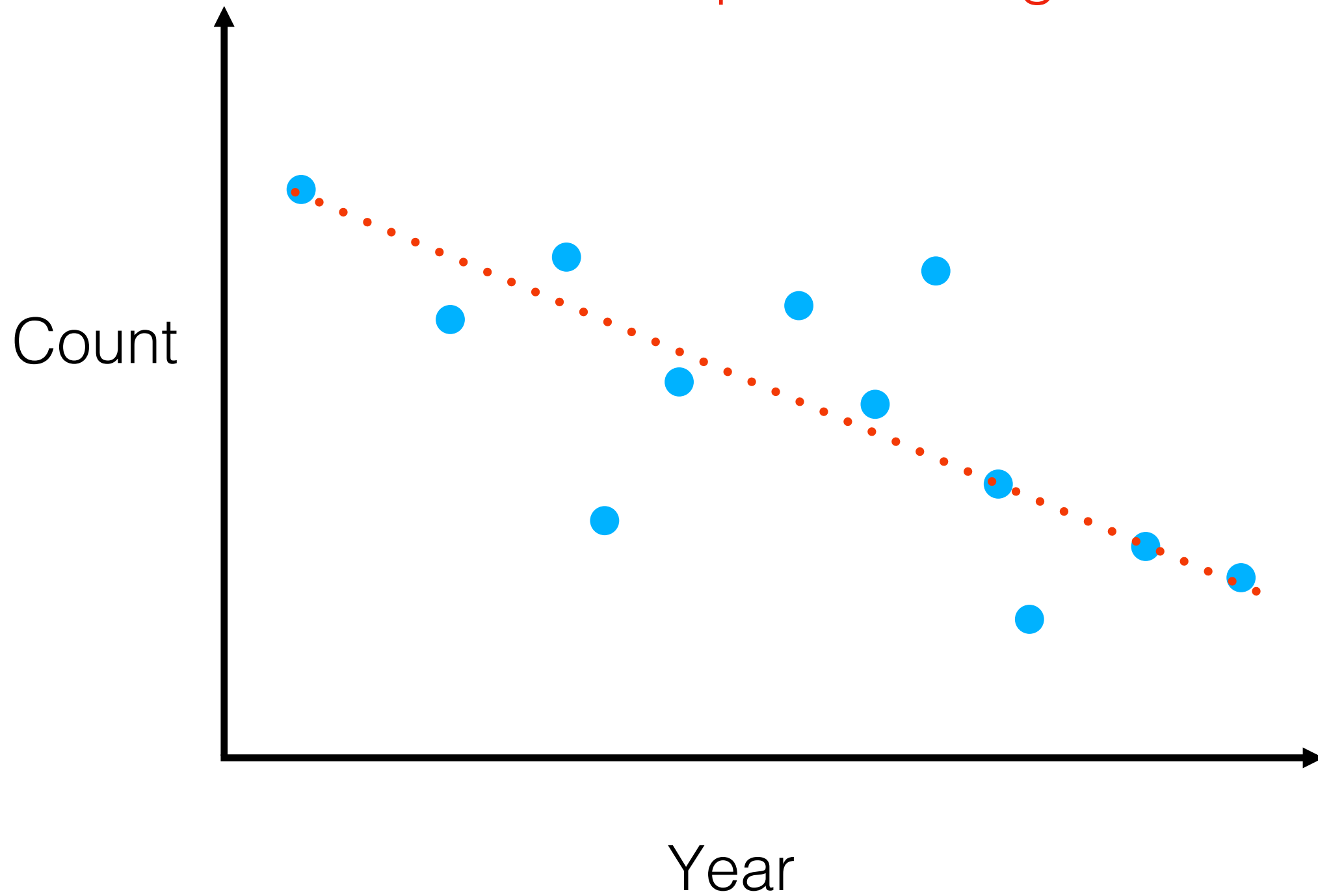
Used continuous range rather than breaking it into arbitrary periods for comparison

Included time of year when survey took place

Using Bayesian framework to include uncertainty

Investigating inclusion of Southern Oscillation Index

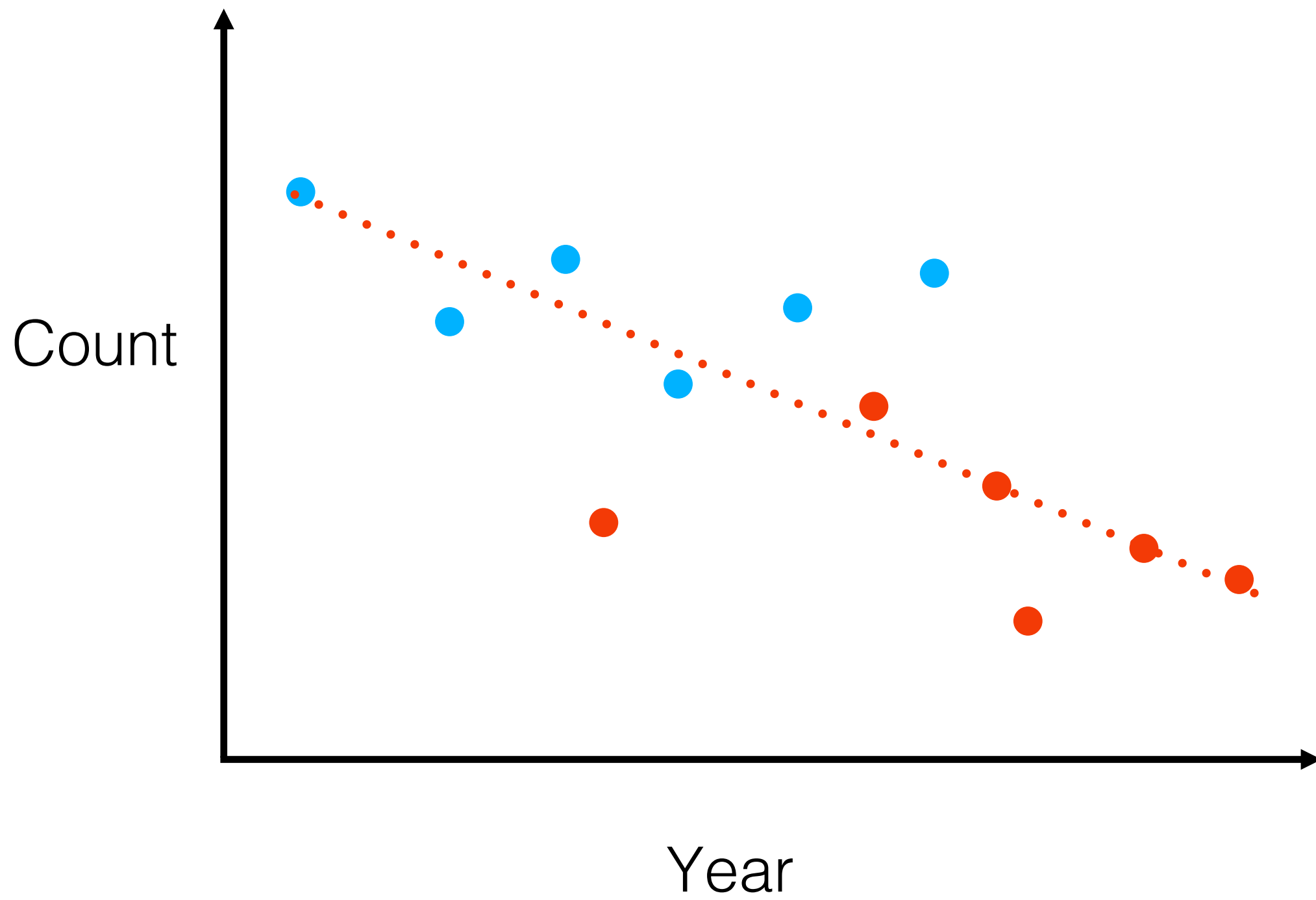
Trend line slope = average decline per year

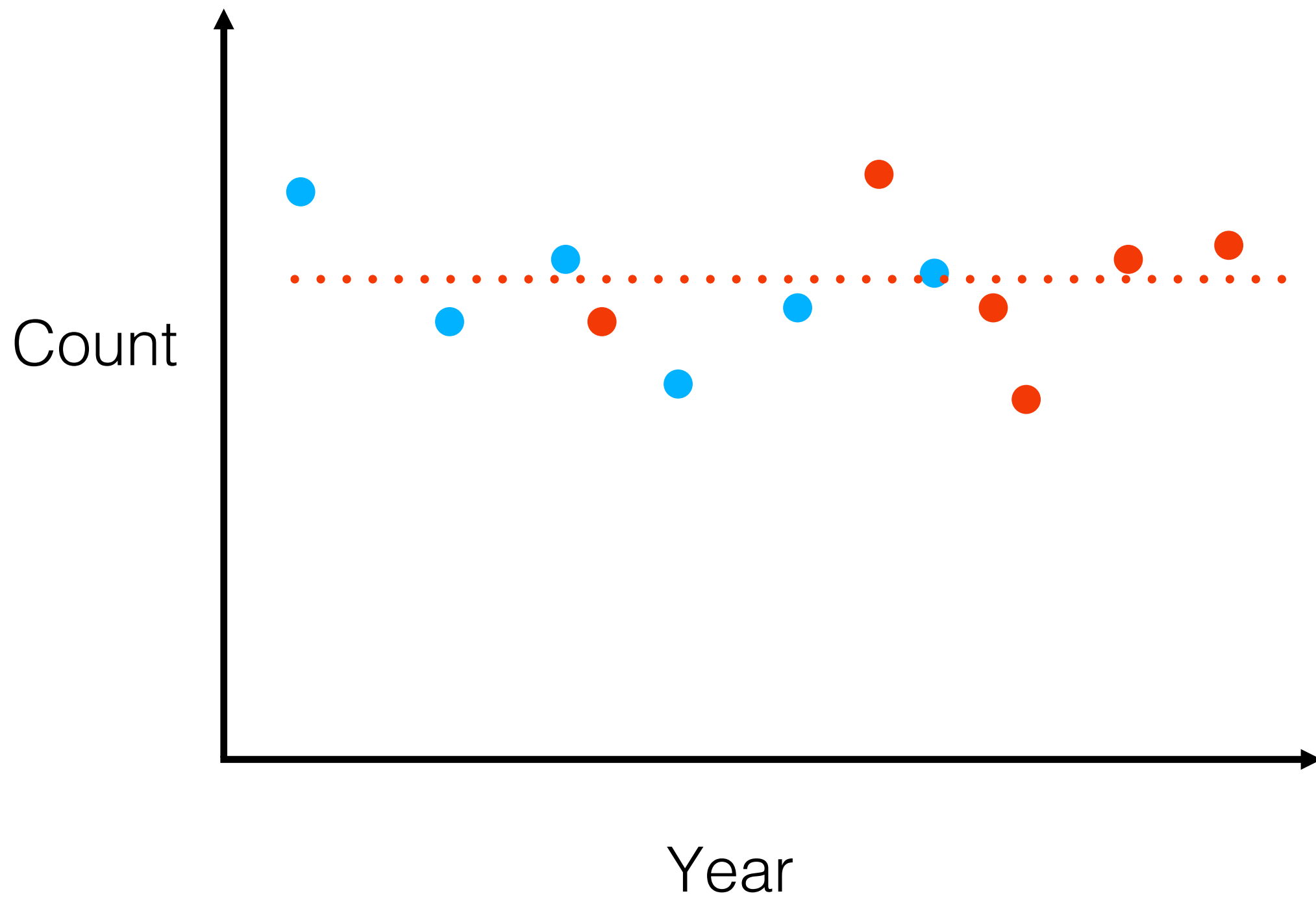


month	year
10	1979
12	1980
6	1980
11	1981
6	1981
11	1982
7	1982
4	1983
7	1983
7	1984
7	1985
8	1987
7	1988
6	1991
11	1994
12	1994
11	1996
12	1996
6	1996
11	1997
12	1997
11	1998
12	1998
11	2000
7	2000
11	2002
2	2002
6	2002
10	1994
11	1999
12	1999
12	2001
12	2002

Lots of winter observations

Lots of summer observations



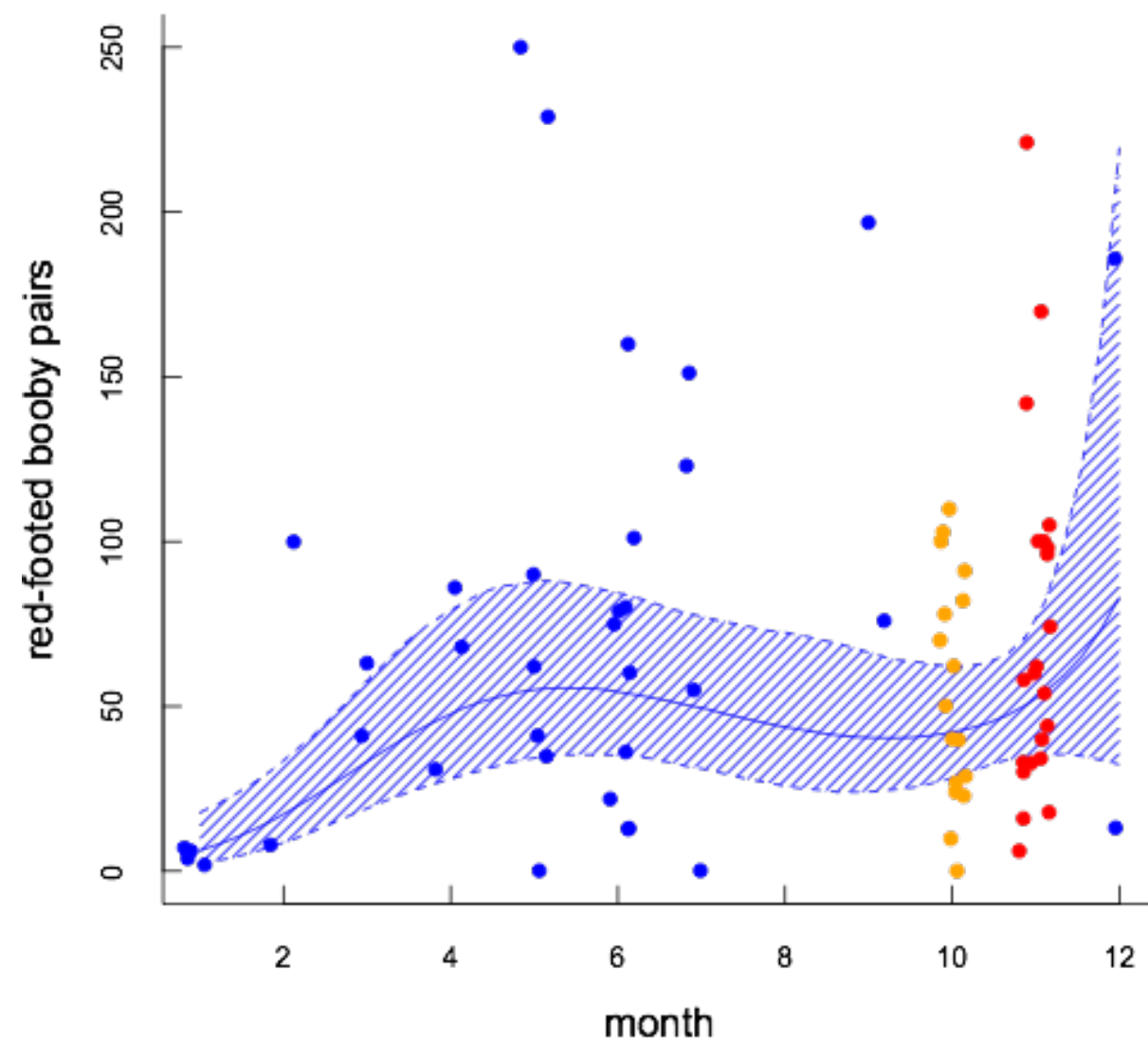
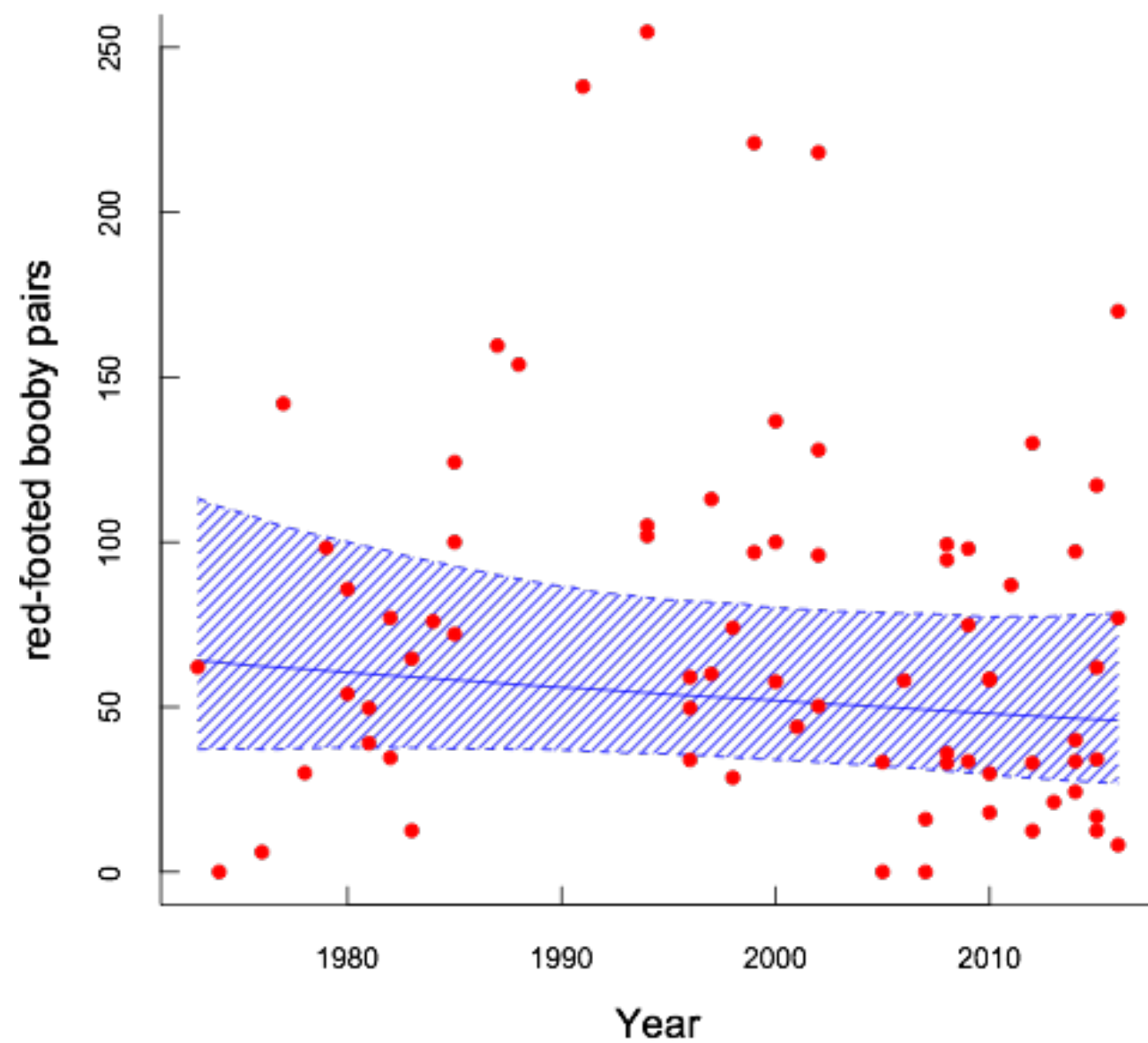


Model basic structure

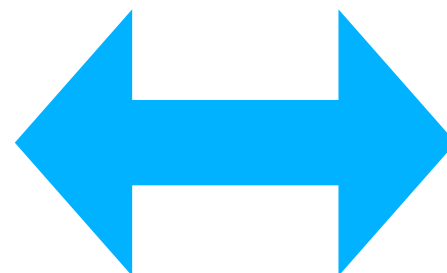
Breeding pairs = intercept + year



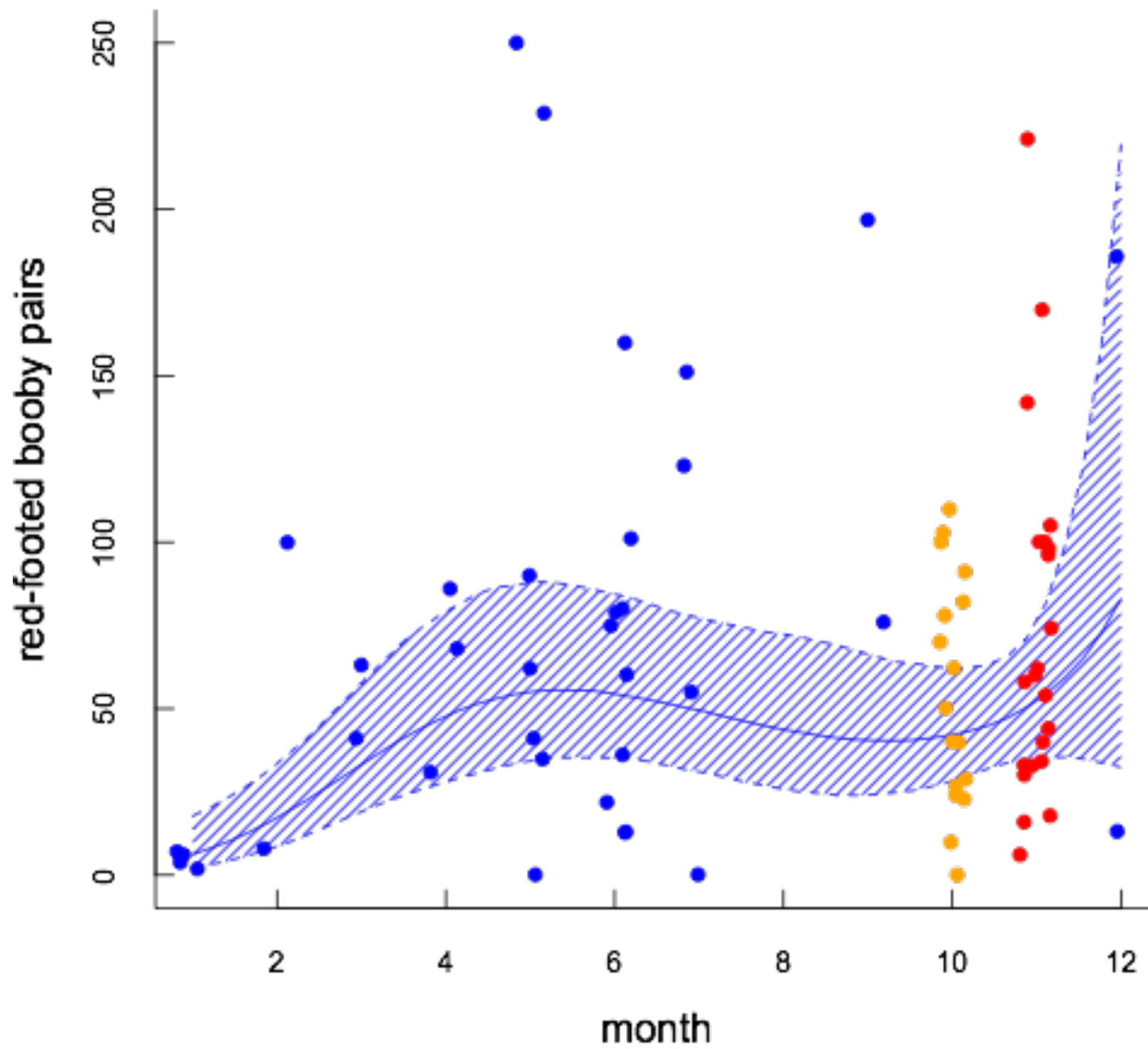
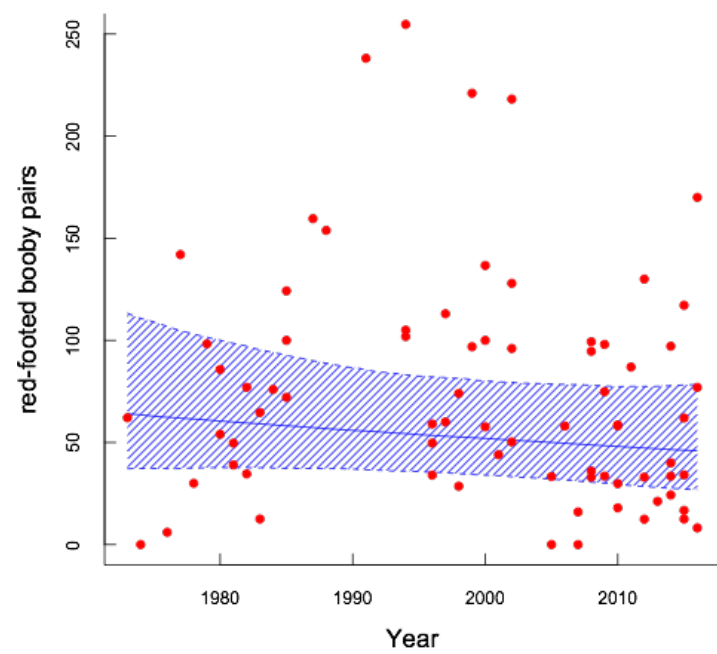
Monthly variation in breeding

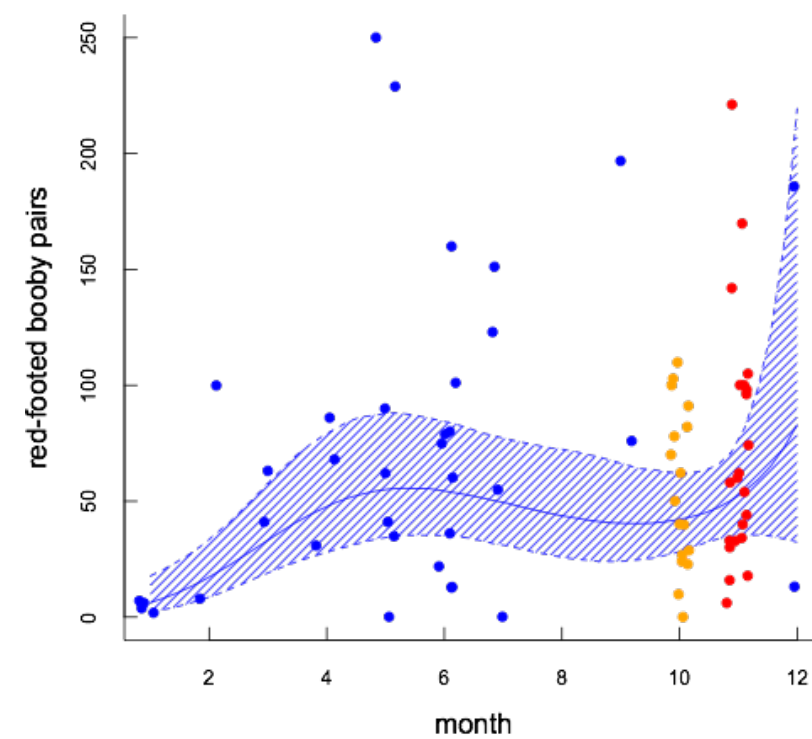
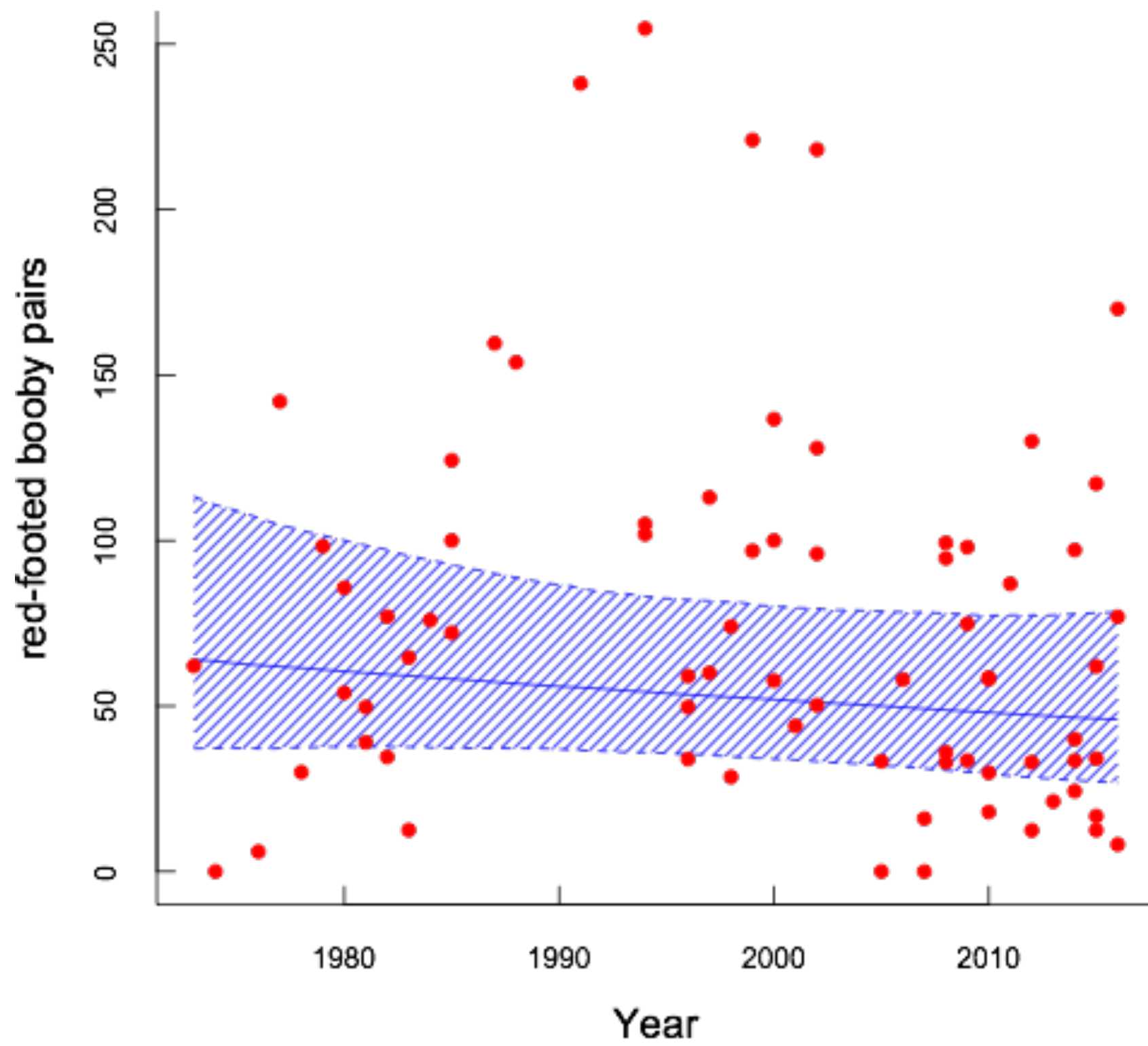


Yearly trend

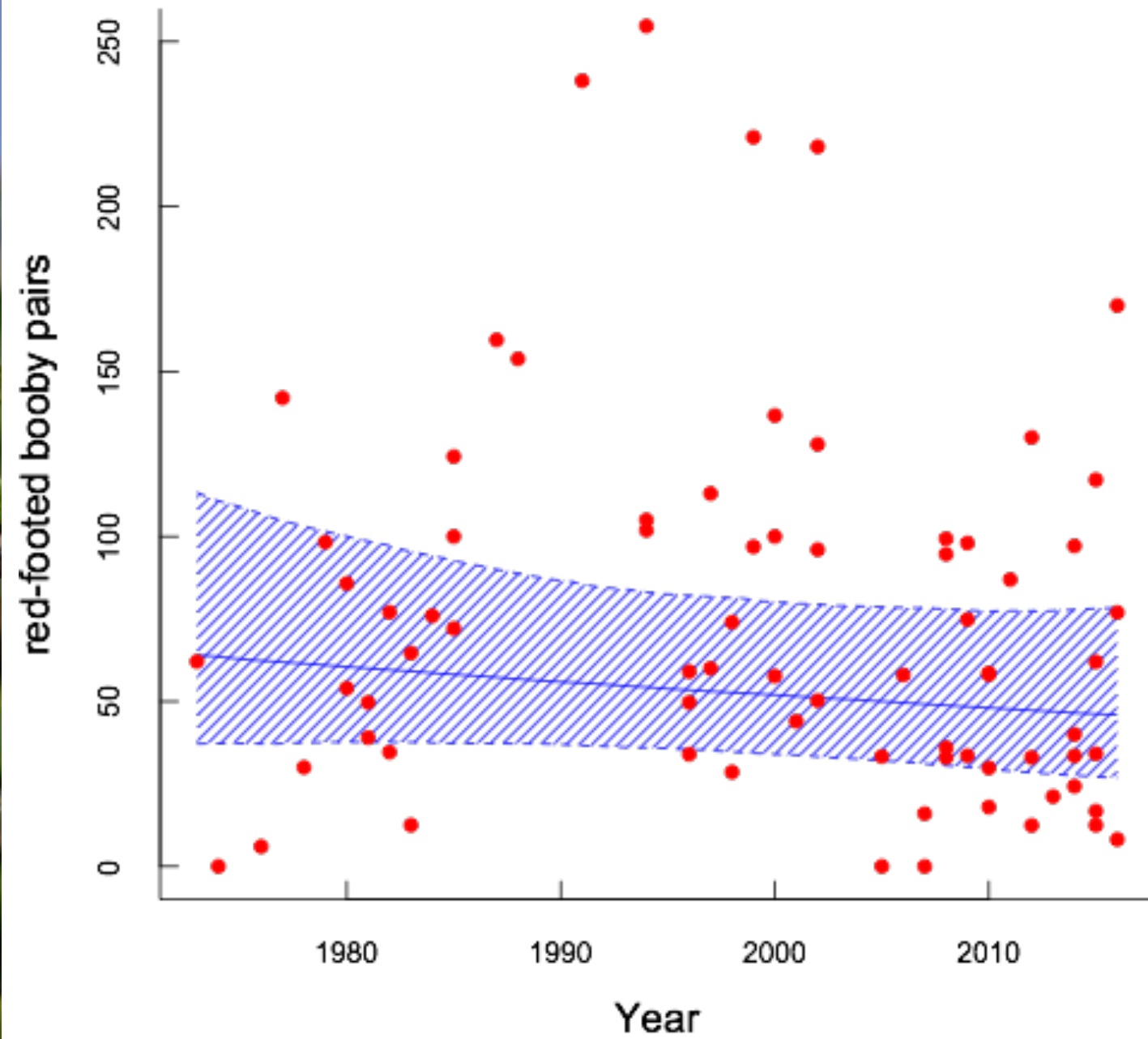


Seasonal effects



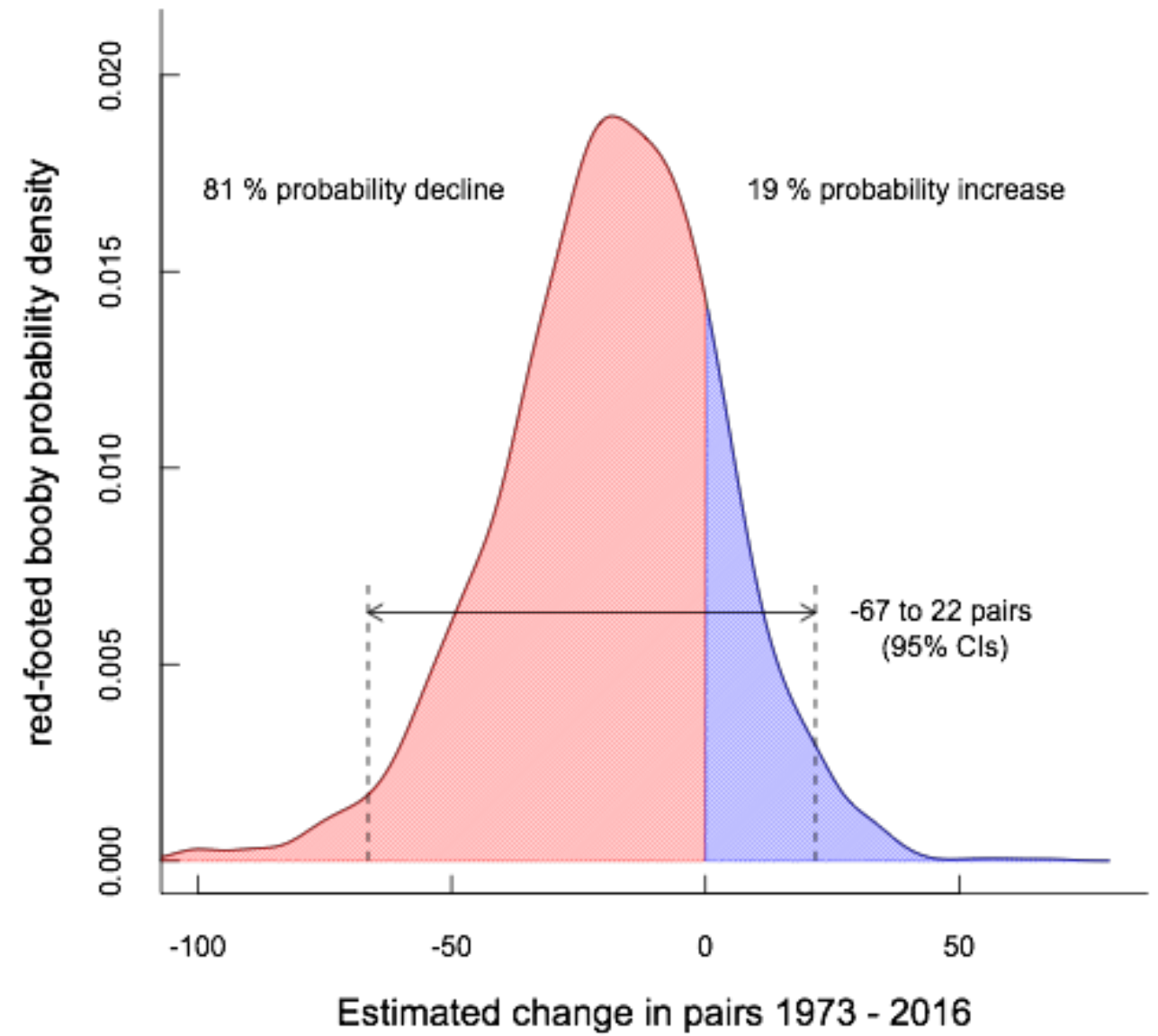


Red-footed Booby



Batianoff & Cornelius say large population decline

Red-footed Booby

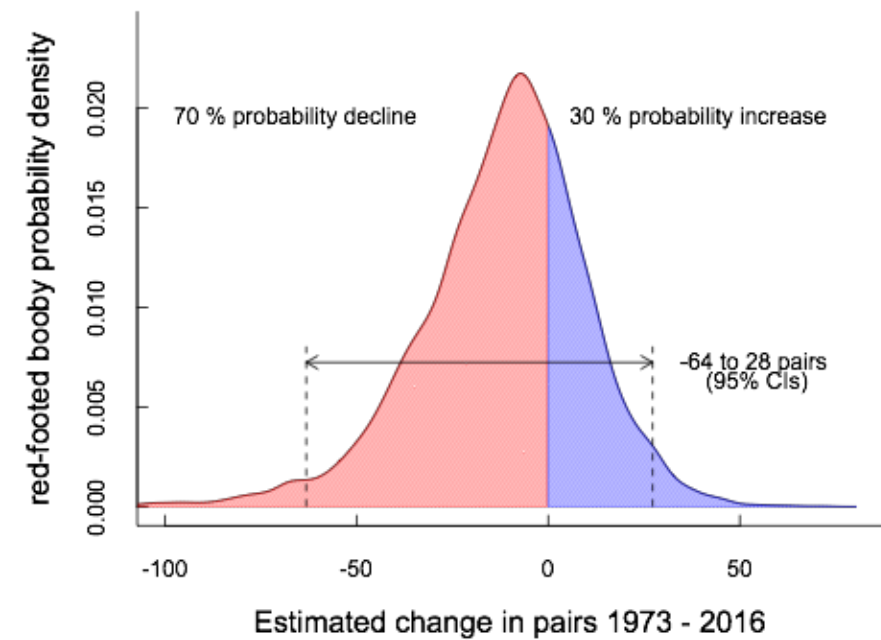
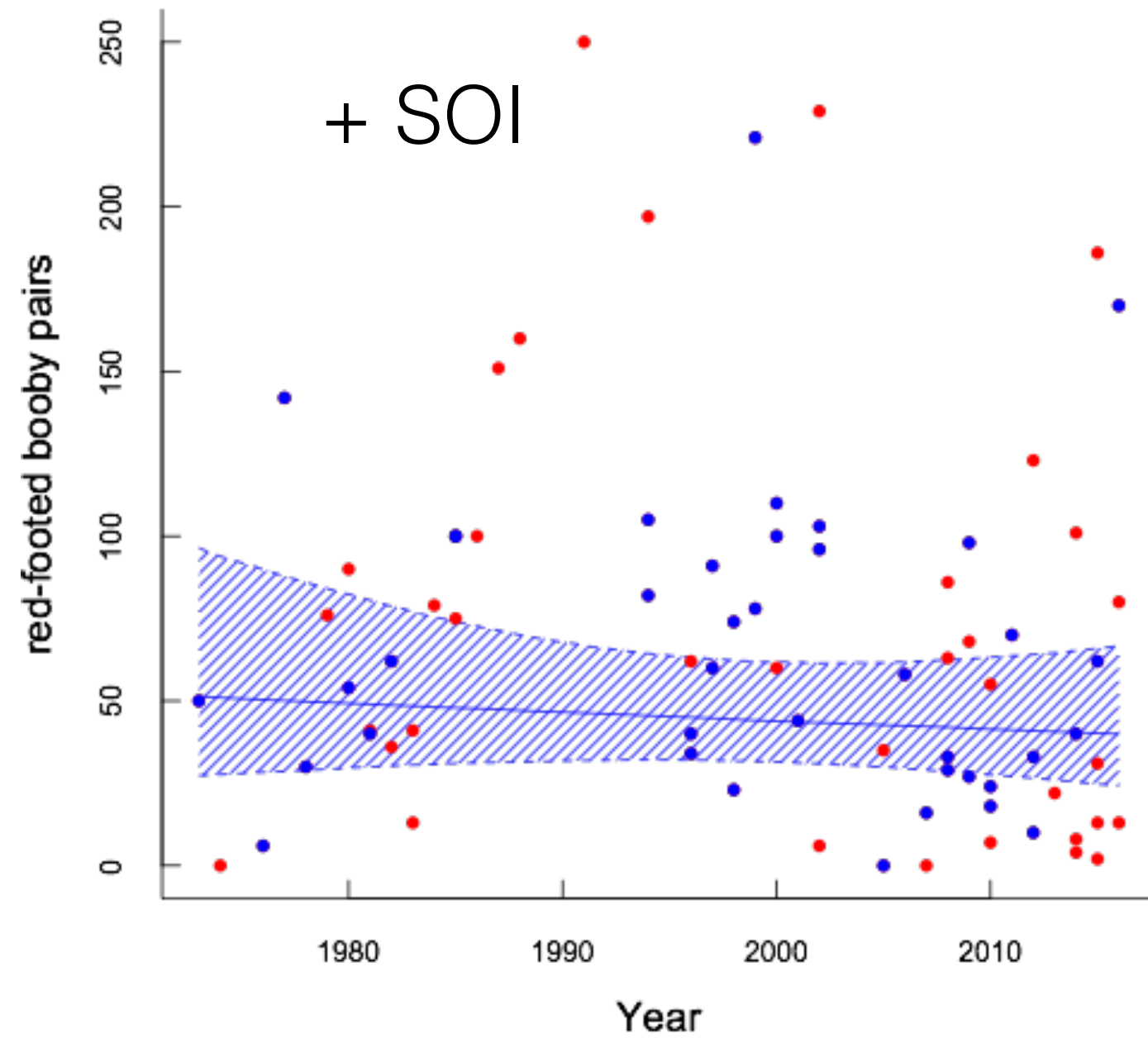


Do we have a decline?

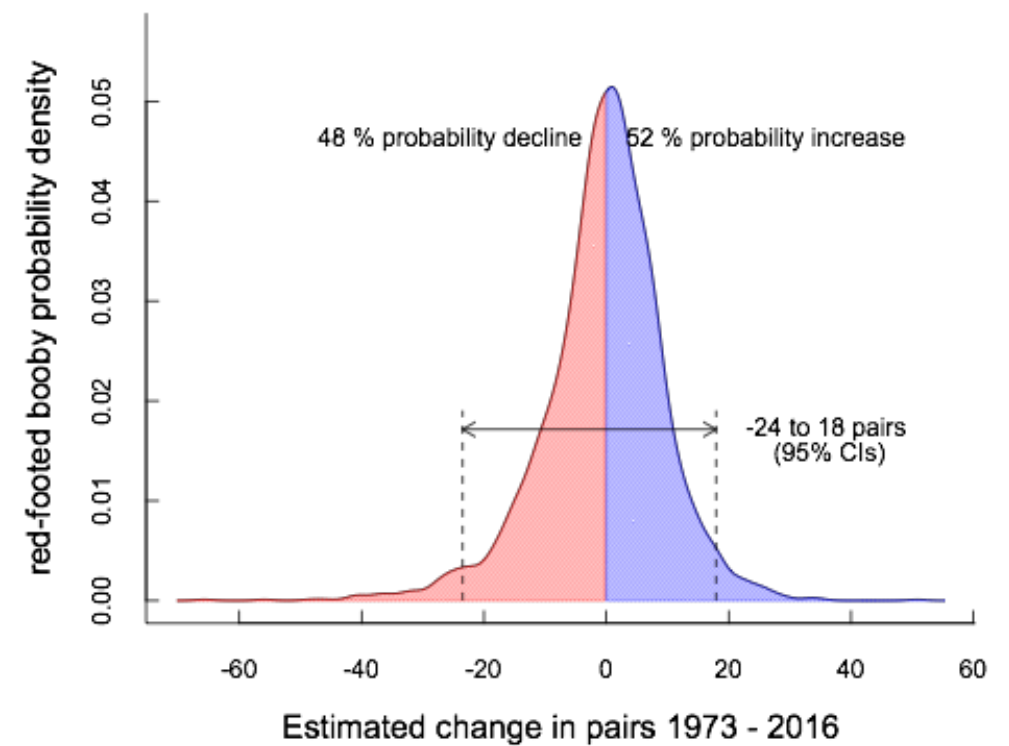
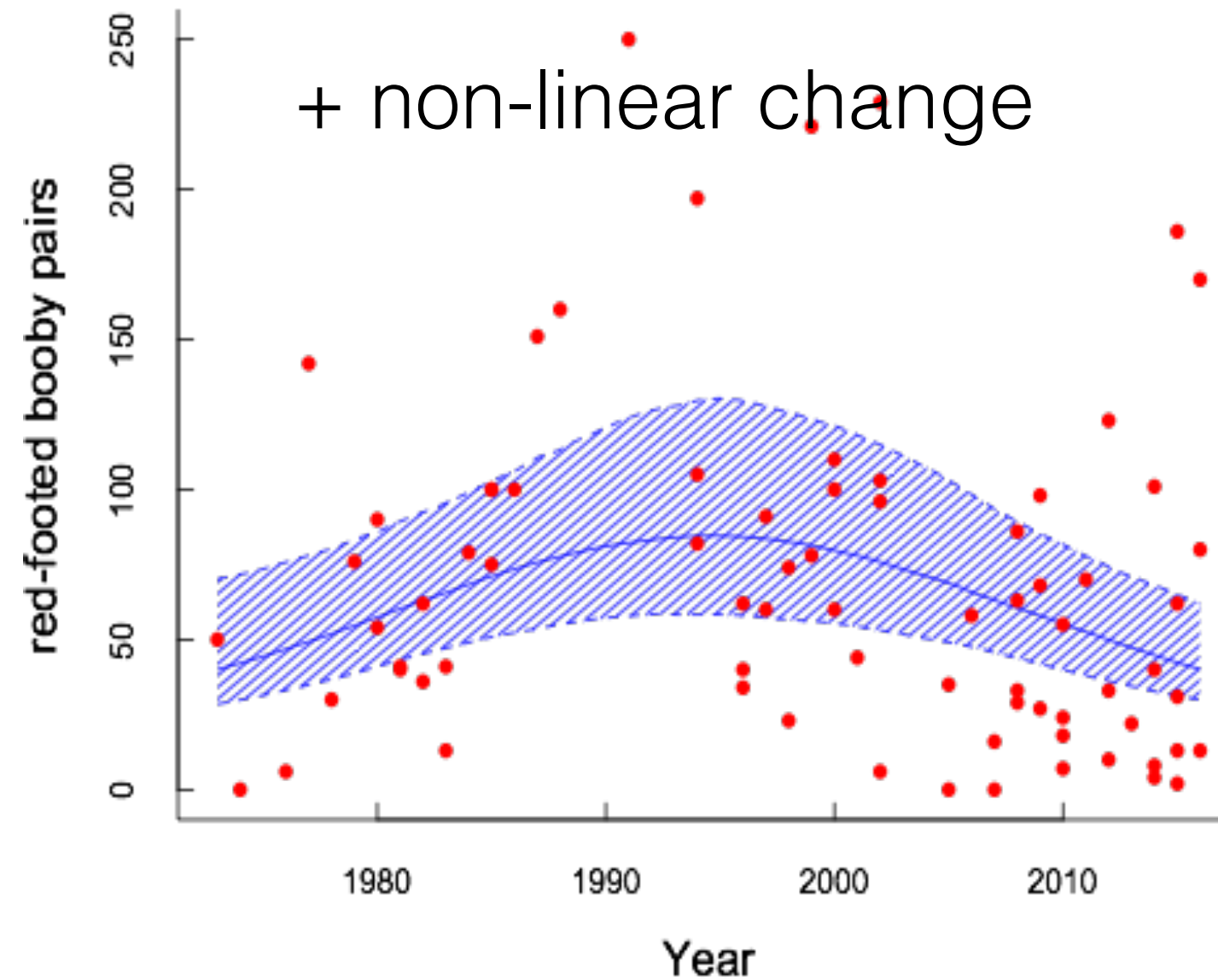
Red-footed Booby



Do we have a decline?

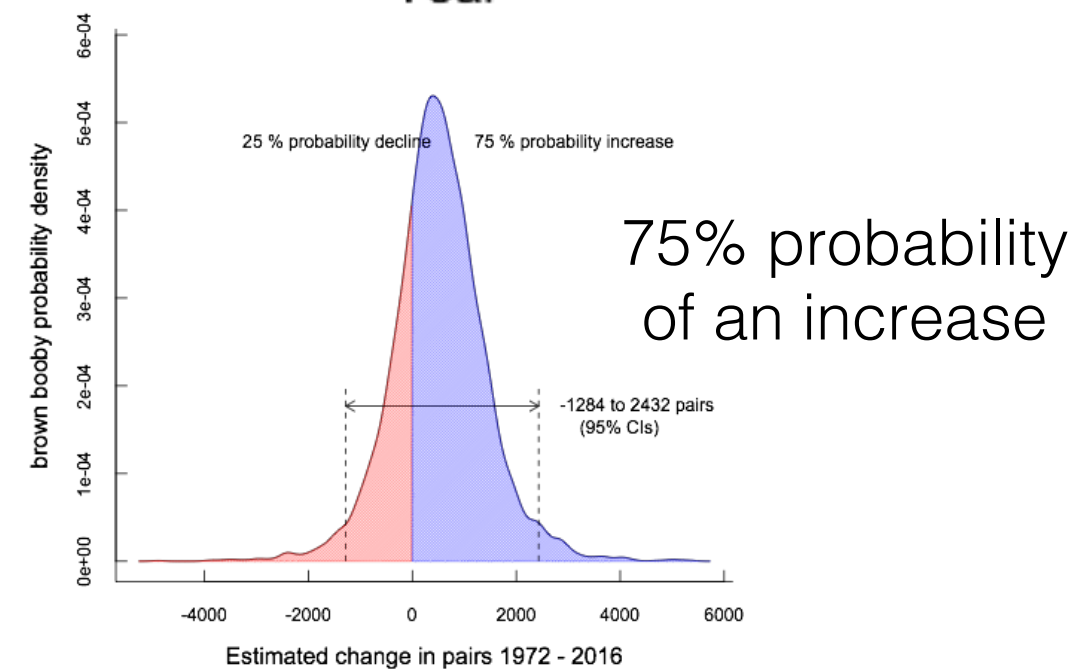
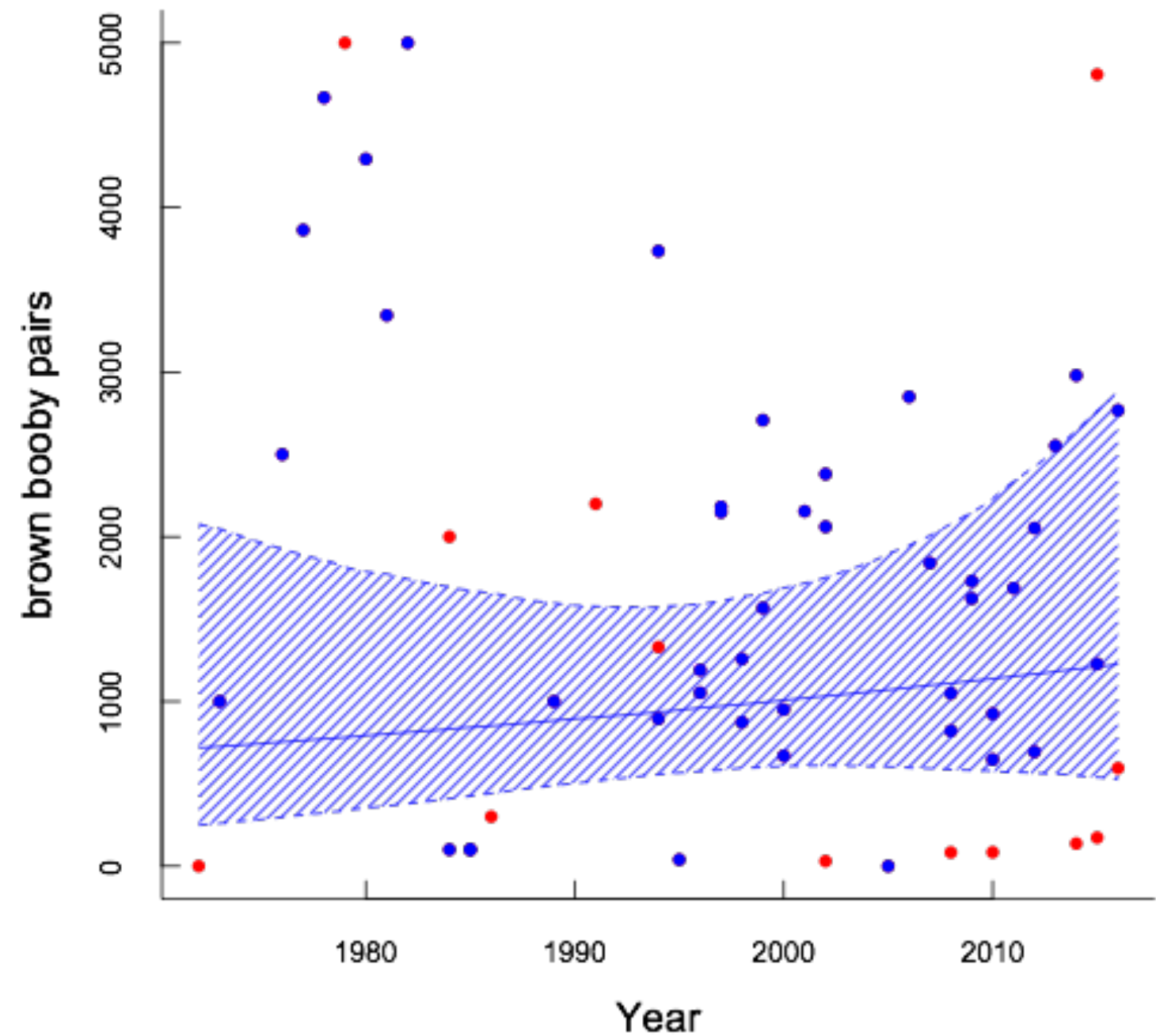


Red-footed Booby



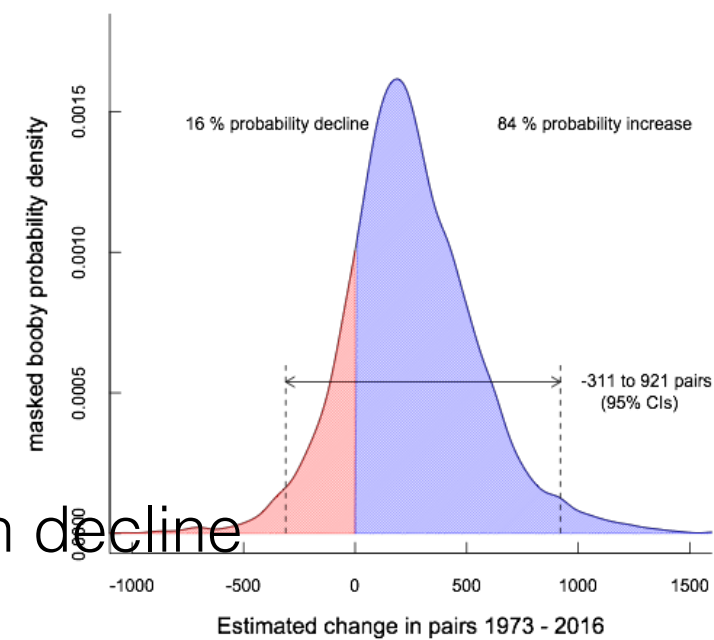
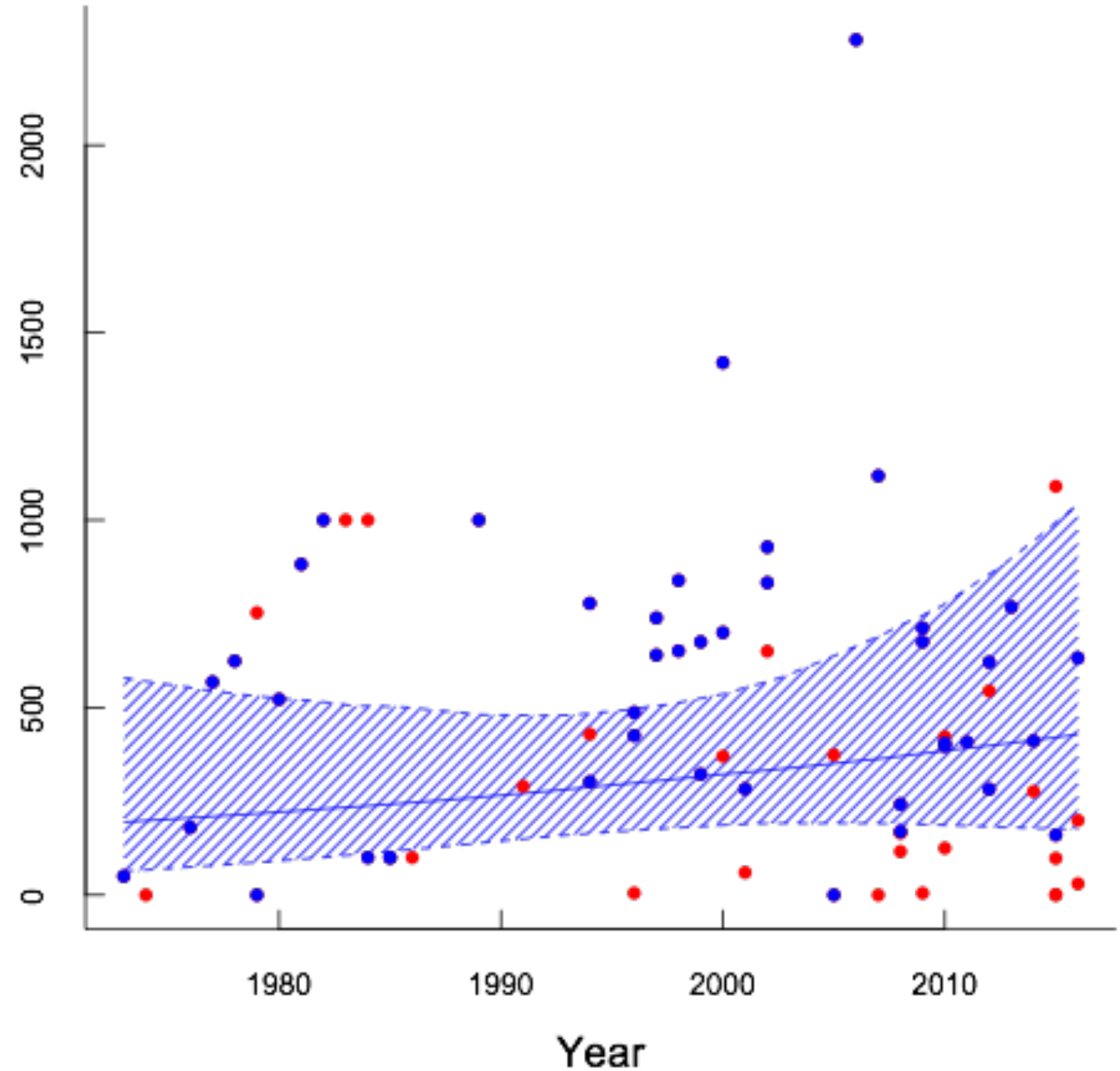
Do we have a decline?

Brown Booby



Batianoff & Cornelius say large population decline

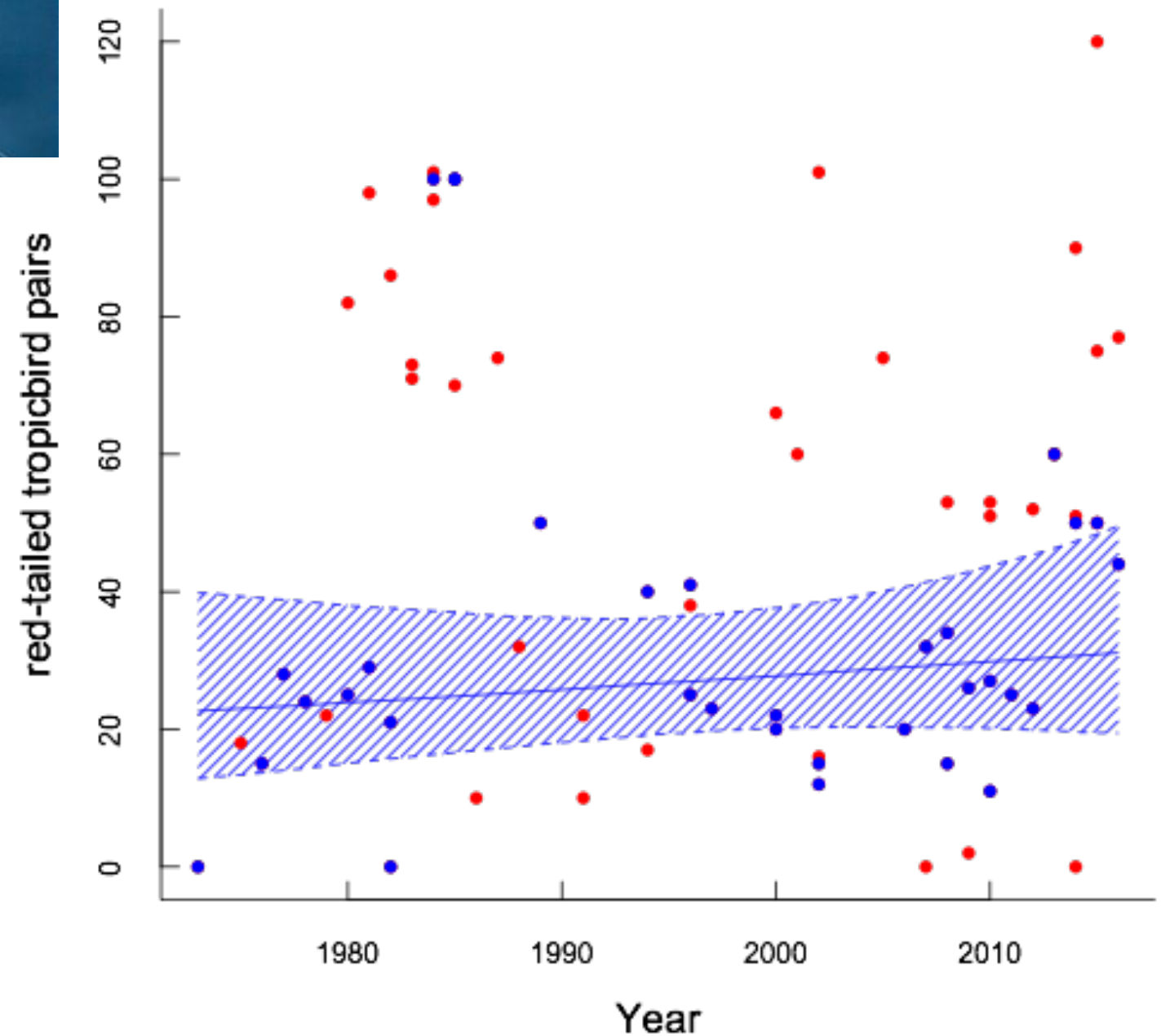
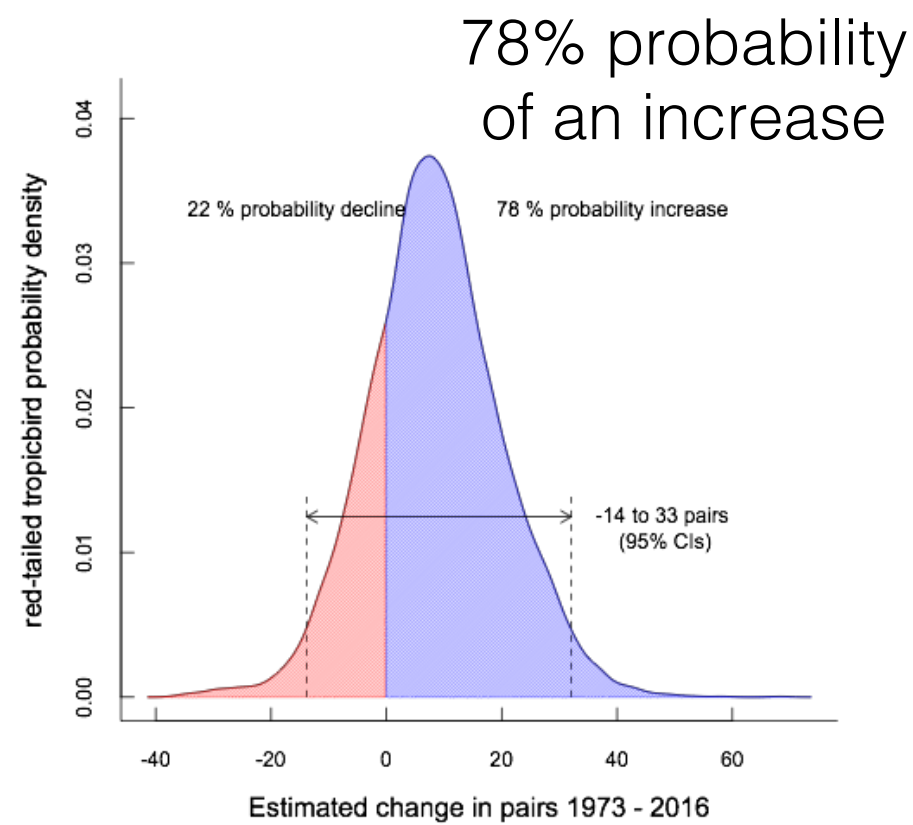
Masked Booby



84% probability
of an increase

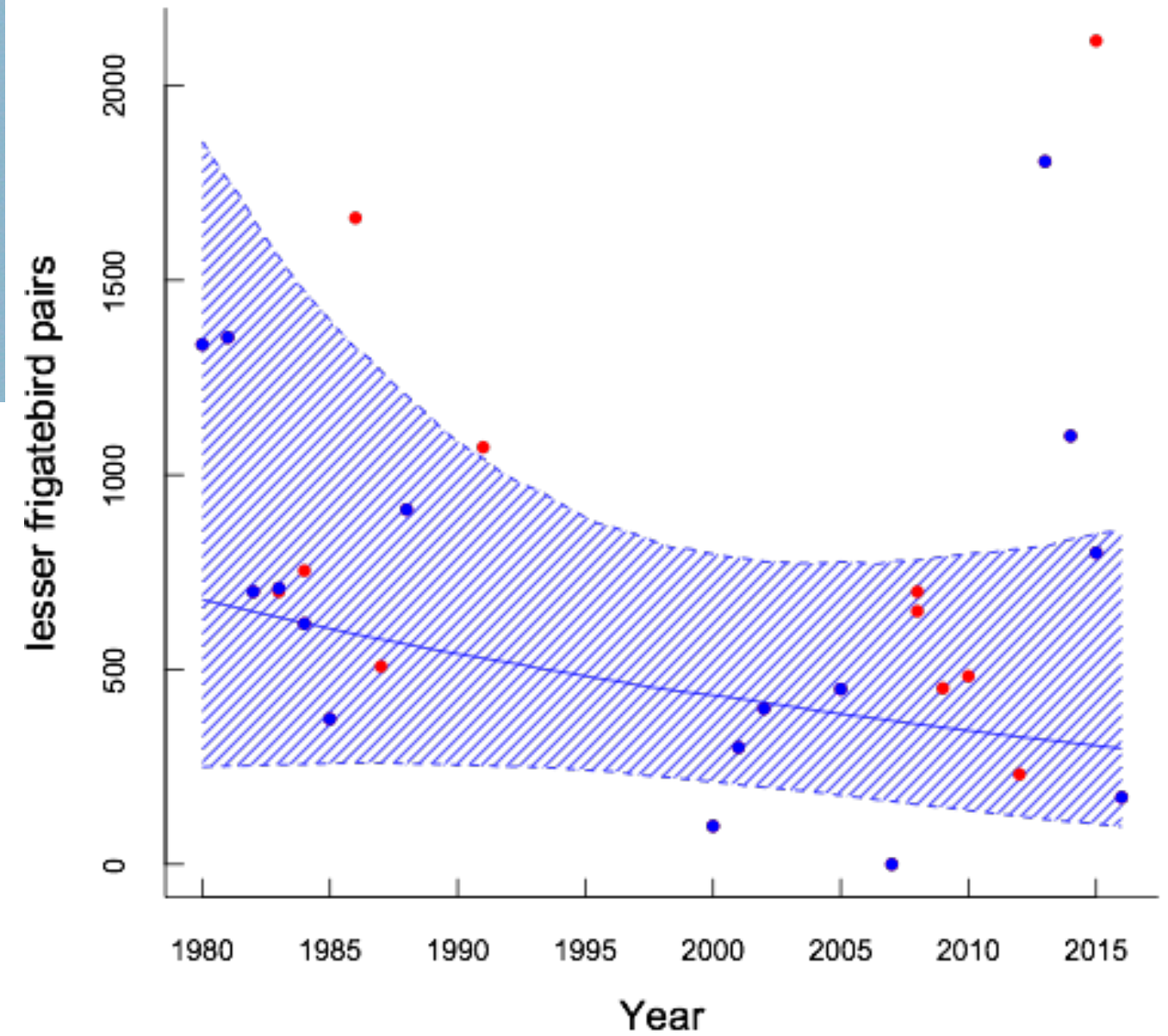
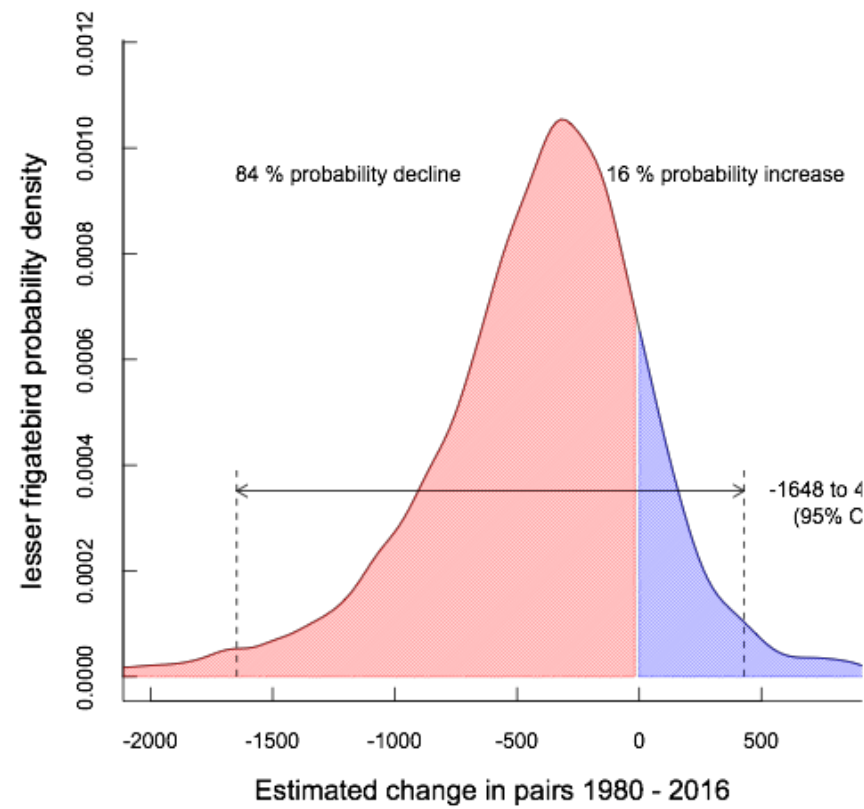
Batianoff & Cornelius say moderate population decline

Red-tailed Tropicbird



Batianoff & Cornelius say moderate population decline

Lesser Frigatebird



84% probability
of a decline

Batianoff & Cornelius say large population decline

What about the Common Noddy?

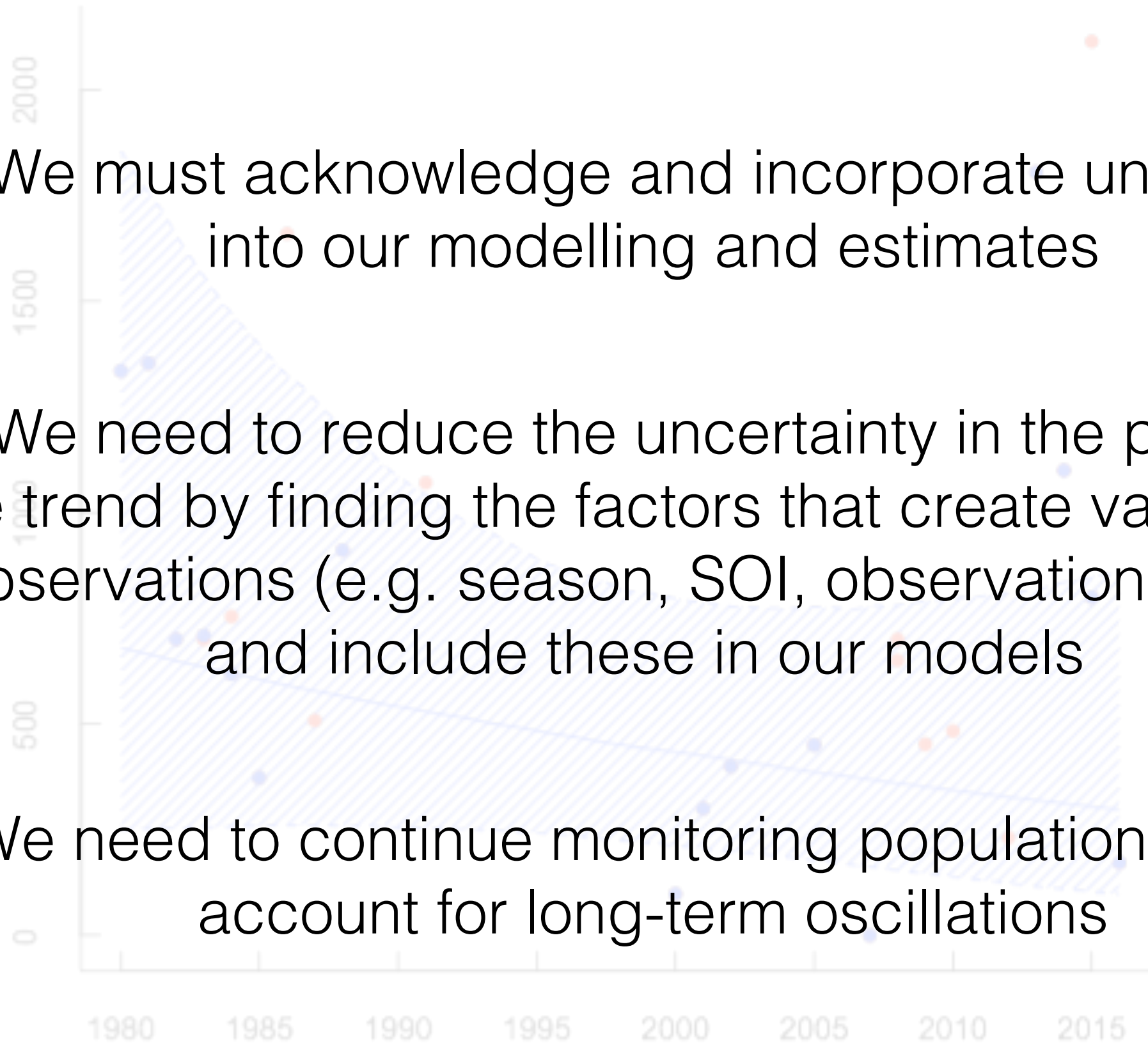
11693 → 526

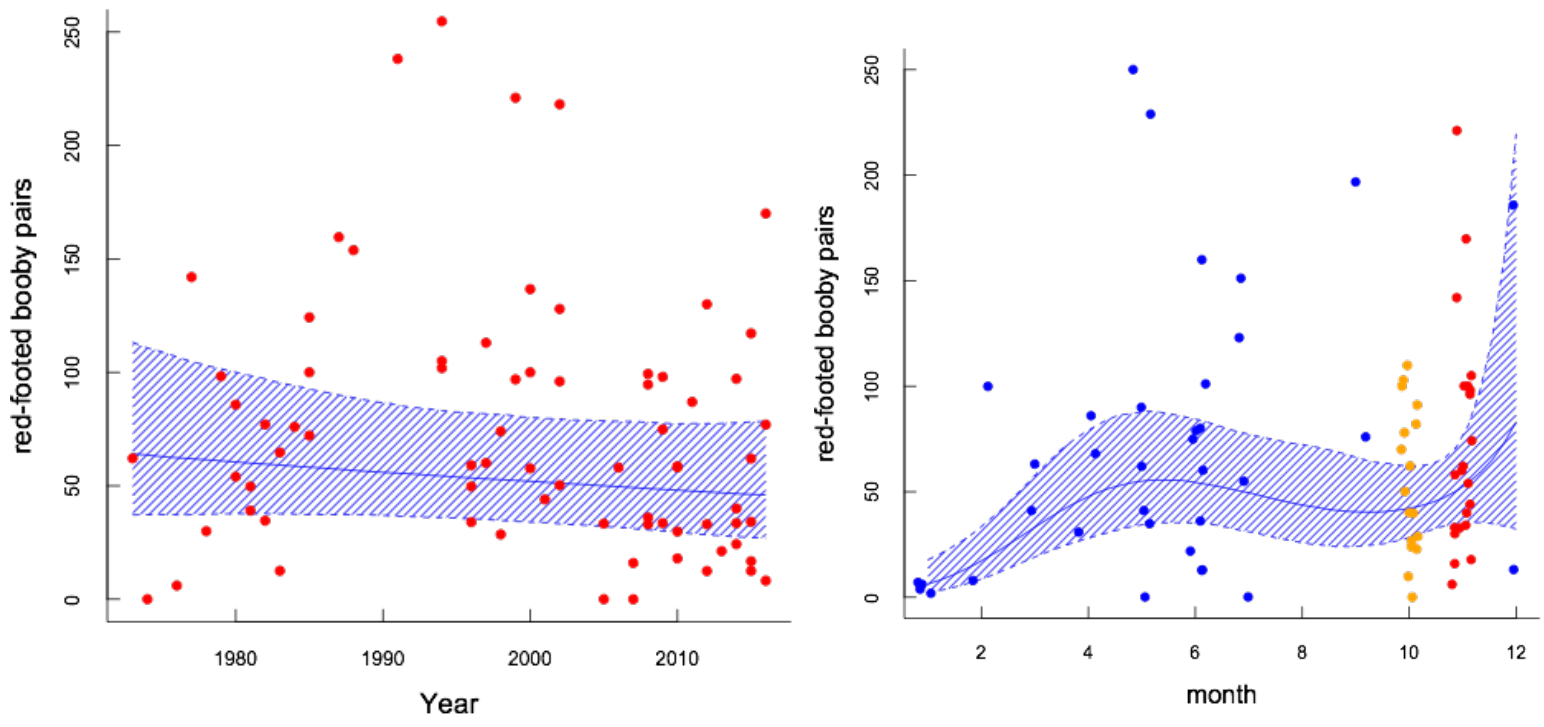
-95.5%

month.name	year	count	month
Sep	197	0	9
Oct	197	500	10
Jun	198	6100	6
Jul	198	17000	7
Apr	198	5000	4
Jul	198	7000	7
Apr	198	1000	4
Jul	198	10000	7
Jul	198	5552	7
Mar	198	2000	3
Aug	198	553	8
Jul	1988	2655	7
Jun	1996	1171	6
Nov	2000	160	11
Jul	2000	1000	7
Jun	2002	1900	6
Jun	2005	2258	6
Jun	2007	0	6
Apr	2008	720	4
May	2009	1581	5
Aug	2010	870	8
Nov	2011	0	11
Aug	2012	553	8
Dec	2012	4522	12
Jul	2013	9350	7
Mar	2014	23	3
Jul	2014	3945	7
Jul	2015	82	7
	2016	55	7

The main issue is uncertainty

1. We must acknowledge and incorporate uncertainty into our modelling and estimates
2. We need to reduce the uncertainty in the pattern of the trend by finding the factors that create variation in observations (e.g. season, SOI, observational error) and include these in our models
3. We need to continue monitoring populations to better account for long-term oscillations





Thanks to all the people who do the bird counts and support the science on Raine Island!

And thanks to the Swedish Research Councils for funding