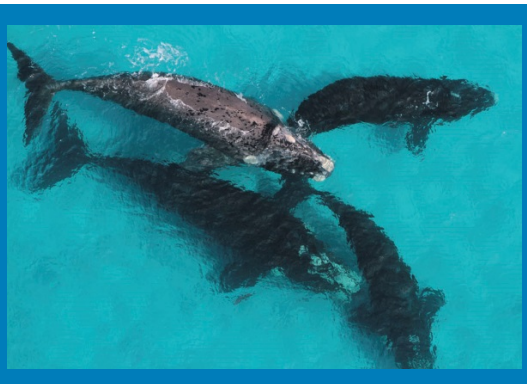
Marine Biodiversity Hub

National Environmental Science Programme

Project A7 -
Monitoring Population Dynamics of 'Western' Right Whales off Southern Australia 2015-2018

Project Leader: J L Bannister

Research Plan 1 – 2015
Final Report on activities
30 March 2016



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EXECUTIVE SUMMARY

To continue an annual series of aerial surveys off the southern Australian coast between Cape Leeuwin WA and Ceduna SA since 1993, an aerial survey was undertaken as planned over six days, 2-6 September, 2015. For comparison with previous results, counts were obtained of 462 individuals including 97 calves of the year. From 3679 photographic images obtained, 377 have been selected for computer-assisted 'matching' with those (some 6600 images of 2175 individuals) already available in the catalogue, and 126 data sightings sheets have been added to the sightings database, currently totalling 3670 sightings sheets.

The 2015 counts were considerably lower than in recent years, particularly for cow calf pairs, which were the lowest recorded since 2007.

Regression analysis of log number against year for the period 1993-2015 gives increase rates, for all animals of 0.0563 (95% CI 0.0380, 0.0747) (exponential rate) or 5.79 (95% CI 3.87, 7.75) (percent), and for cow/calf pairs 0.0588 (0.0324, 0.0852) or 6.06 (3.29, 8.89) respectively.

Current population size, for this the 'western' Australian subpopulation, is estimated at 2266.

INTRODUCTION

Southern right whales were reduced almost to extinction by 19th Century whaling, throughout the southern hemisphere but including off Australia. There have been signs of recovery off the southern Australian coast, particularly off WA and western SA (the 'western' Australian subpopulation), particularly since the mid-1970s, given cessation of whaling on the species. Since1976, aerial surveys have been undertaken annually to determine numbers and population trend and obtain individual identifying photographs, at first along the WA south coast from Cape Leeuwin east to Twilight Cove, but from 1993 extending into SA waters to as far as Ceduna, given earlier evidence of intra- and inter-season coastal movement. Further east around the Australian coast there has been little sign of recovery in number; a working hypothesis assumes separation between two subpopulations – 'western' and 'eastern'. This report gives the results of a planned aerial survey between Cape Leeuwin and Ceduna in August/September 2015, the 23rd in an unbroken series since 1993.

1. PROJECT SUMMARY

Aerial survey, Cape Leeuwin-Ceduna and return, with an additional leg Augusta-Perth up the west coast, was undertaken successfully, as planned, between 2 and 9 September.

Extraction of count data was undertaken successfully, as planned, by 30 October. The counts, particularly for cow/calf pairs, were considerably lower than in recent years, indeed the lowest since 2007.

3679 identification photographs were selected, as planned, by 15 November, resulting in 377 images from the 2015 survey being added to those awaiting processing (matching) from previous years (669 from 2013 and 2014).

Sightings data were incorporated, as planned, into the sightings data base by 30 January 2016. 126 datasheets have been added to the existing database, which now totals 3670 sheets.

Trend analysis, undertaken by Prof Philip Hammond, University of St Andrews, Scotland, for the data from 1993, gives increase rates, for all animals of 0.0563 (95% CI 0.0380, 0.0747) (exponential rate) equivalent to 5.79 (95% CI 3.87, 7.75) (percent) per annum, and for cow/calf pairs 0.0588 (0.0324, 0.0852) and 6.06 (3.29, 8.89) per annum, respectively. The rates are lower than in recent years because of the low counts in 2015.

Current population size, for this the 'western' Australian subpopulation, is estimated at 2266.

2. AIMS

a) continue collection of the dataset, i.e. counts and photographs, of southern right whales, from the southern coast between C Leeuwin WA and Ceduna SA, as in each year since 1993. Obtain estimates of population trend since 1993, and current population size.

b) continue 'matching' photographs of head callosities obtained on the flights using a computer-assisted system against those (2000+ individuals) in the existing identification catalogue. Obtain information on current and past distribution and, in due course, biological parameters such as age at first parturition and calving rate.

c) continue databasing existing information on sightings, linked to animals already identified.

3. APPROACH

As in previous years one flight was to be undertaken from a high wing, single engine aircraft based on Albany WA, over *ca* 39 hours, for four-five flying days. When whales are sighted, a count is made and individuals are circled for photography, and the GPS sighting position is recorded, as latitude and longitude. For individual identification, clear images of the head callosity pattern and/or other identifying characteristics are required.

As in previous years, direct counts were to be obtained of animals observed within the search area. Photographs were to be obtained of as many animals as possible but with emphasis on cows with calves. The search area includes virtually all the area to which 'western' right whales resort in winter/spring, close to the coast, in particular for females to give birth, generally at three-year intervals.

As in previous years, the maximum count on the flight is to be compared with results since 1993 to obtain estimates of a) population trend and b) current population size

Population size is currently obtained using a simple model based on the numbers of cow/calf pairs sighted. Given the relative paucity of animals that visit the remainder of the southern Australian coast, the 'western' population recorded between C Leeuwin and Ceduna is considered to represent the majority of the 'Australian' population.

Photographs from the flights are added to the 'WA' catalogue for computer-assisted 'matching' with those already available from WA and elsewhere, including the Antarctic. Sightings information is added to the existing sightings database which relates detailed sightings information to individuals already identified photographically.

4. RESULTS

Aerial Survey

In six days, 2-6 September 2015, over 10 'flying' legs, during 39.71 flying hrs, there were sightings of 896 whales including 172 calves of the year (Table 1). Flying was delayed by one day on leg 2, at Esperance, because of a waterlogged airstrip at Caiguna, WA.

For comparison with previous years, and given that nine legs were, as usual, flown twice ('outwards' and 'inwards'), the comparable count (combining the maximum for each leg) was 462 including 97 calves (Table 2). The counts were considerably lower than expected, indeed the lowest since 2007.

Regression analysis of the annual data 1993-2015, undertaken by Prof Philip Hammond of the University of St Andrews, Scotland, gives an estimated annual exponential rate of increase for all animals of 0.0563 (95% CI 0.0380, 0.0747) equivalent to an increase of 5.79% (95% CI 3.87, 7.75) per annum, and for cow/calf pairs 0.0588 (0.0324, 0.0852) or 6.06% (3.29, 8.89) per annum, respectively (Table 3, Figure 3). As expected, the rates of increase of all animals and cow/calf pairs are both somewhat lower given the lower new counts. They are slightly less precise than the equivalent rates of increase estimated last year but the fit of the regressions to the data are still very good.

Prof Hammond reports that for the first time, inspection of the residuals of the fitted exponential regressions (Figure 3) reveals weak evidence that the growth rate may be starting to show signs of slowing. However, this pattern is strongly influenced by the lower than expected counts in 2015 and an exponential increase is still the best description of the data. If the low 2015 counts are anomalous, future counts may be expected to continue to show an exponential increase. However, if this is not the case, it may be useful in future to explore models of population growth other than simple exponential growth to investigate more robustly whether the growth rate is starting to slow down.

Current population size is estimated using a simple model adopted at the International Right Whale Workshop held in Buenos Aires, Argentina, in September 2011 (IWC, 2013), based largely on evidence from increasing populations off Argentina and South Africa, whereby the cow/calf count over three years (to allow for the 3-year periodicity in calving) is multiplied by a factor of 3.94. For the 'western' Australian subpopulation this results in current population size, i.e. for the middle year (2014) of the three-year period (2013-15), of 2266.

Photography

From 3679 images obtained on the flight, 377 were selected for 'matching' with those (some 6600 images) already available in the catalogue.

Current distribution

As in past years the 2015 flights recorded concentrations of particular classes of animals at various locations along the coast. Cow/calf pairs, i.e. adult females with calves of the year, were found particularly in and near Doubtful Island Bay (including near Point Ann and Point Charles), in Israelite Bay and along the coast to its north east (all in WA) and at Head of Bight (SA) (Figure 2a). 'Unaccompanied' animals, mostly adults but with no associated calves, were as usual distributed much more widely along the coast (Figure 2b). Particular concentrations were recorded near Albany and eastwards towards Doubtful Island Bay, in Yokinup Bay (west of Cape Arid), at and northeast of Israelite Bay, and in and to the east of Twilight Cove (all in WA), then along 'the cliffs' east of Eucla and at Head of Bight (SA).

Databasing

For 2015, 126 data sightings sheets have been added to the sightings database, currently totalling 3670 sheets for sightings recorded over the period 1976-2015. These are mainly records from aerial survey but they include some others records, e.g. from Antarctic sightings cruises.

Data archiving

Previous count data, sightings and individual whale sheets have been archived at the Australian Antarctic Division Archives, Hobart. Those from 2015 are being forwarded to that archive.

Acknowledgements

Jenny Schmidt (flying for Great Southern Aviation, Albany, WA) piloted the flight, with Andrew Halsall (Andrew Halsall Photography) as observer/photographer: their hard work and dedication are acknowledged. Dr Josh Smith (Murdoch University) produced Figure 1 and Figure 2. Prof Philip Hammond (St Andrews University, Scotland) undertook the trend analysis and advised on the results. Dr Mike Double (Australian Marine Mammal Centre, Hobart) advised on databasing and allied matters.

Facilities and administrative and other assistance continue to be provided to Bannister at the Western Australian Museum through the courtesy of the Trustees, the Chief Executive Officer and the Executive Director, Collections and Research.

References

IWC, 2013. Report of the Workshop on the Assessment of Right Whales. Journal of Cetacean Research and Management 14 (Suppl.), 437-462.

Figures and Tables

Table 1: Right whale aerial survey C. Leeuwin WA-Ceduna SA, 2015. Summary of results.

Flight No.[1]	Date	Leg	Whale sightings								Weather [2]	Flying hrs-mins
			Right whales				Other large whales[3]					
			A[4]	C	Y	T	A	C	Y	T		
Outward legs, from Albany	02/09	1. Albany-Esperance	100	22		122	1	1		2	05/12	5.0
"	03/09	2. Esperance-Caiguna	170	25		195					10/12	5.4
"	04/09	3. Caiguna-Nullarbor, excl Head of Bight*	48	7		55					10/08	5.0
"	04/09	4. Nullarbor-Ceduna,incl Head of Bight	52	25		77					05/12	2.3
Total Outward		*1-4. Albany-Ceduna*	*370*	*79*		*449*						*17.7*
Inward legs, to Albany	05/09	5. Ceduna-Nullarbor incl Head of Bight*	58	32		90					08/20	3.17
"	05/09	6. Nullarbor-Caiguna excl Head of Bight*	32	2		34					20/15	4.42
"	06/09	7. Caiguna-Esperance *	137	26		163					06/17	5.08
"	06/09	8. Esperance-Albany incl Middleton Beach*	94	28		122					15/12	4.42
Total Inward		*5-8. Ceduna-Albany*	*321*	*88*		*409*						*17.09*
Additional legs	07/09	9. Albany-Augusta excl Middleton Beach*	28	4		32	1			1	10	4.92
	07/09	10. Augusta-Perth (Jandakot)	5	1		6	4			4	10/06	
Total additional		*9, 10. Albany-Augusta-Perth (Jandakot)*	*33*	*5*		*38*	*5*			*5*		*4.92*
Total 2015	**6 days**	**10 legs**	**724**	**172**		**896 incl 172 calves**	**6**	**1**		**7 incl 1 calf**		**39.71**
Total 2014		**10 legs**	**747**	**409**		**1156 incl 409 calves**	**17**	**2**		**19 incl 2 calves**		**39.00**

[1] excludes overland (non-sighting) flight Jandakot-Albany, 27/08, 1hr 50 mins [check]
2 as indicated by wind speed, knots
3 all humpbacks; no other large whales recorded
4 A=adult, C=calf, Y='yearling', T=total
* maximum counts used in Table 2

Table 2: B. Right whale aerial survey, C. Leeuwin WA-Ceduna SA, 1993-2015. Comparable numbers seen.

Year	a. All animals	b. 'Unaccompanied' animals	c. Cow/calf pairs
1993	167	47	60
1994	191	95	48
1995	267	139	64
1996[5]	233	123	55
1997[1]	254	148	53
1998	342	120	111
1999	325	157	84
2000	259	113	73
2001	447	163	142
2002	377	163	107
2003	273	85	94
2004	356	142	107
2005	591	237	177
2006	427	127	150
2007	286	172	57
2008	702	230	236
2009	782	294	244
2010	519	251	134
2011	657	185	236
2012	715	275	220
2013	706	214	246
2014	623	159	232
2015	462	268	97

[5] Probable undercounts (see Bannister 1998, 2002)

Table 3: Best fit regressions to the data of Table 2, C. Leeuwin WA-Ceduna SA, excluding 1996, 1997

Period	1993-2015		1993-2014	
Class	**All animals**	**Cow/calf pairs**	**All animals**	**Cow/calf pairs**
Exponential increase	0.0563	0.0588	0.0628	0.0704
SE	0.0088	0.0126	0.0086	0.0115
95% CI	0.0380-0.0747	0.0324-0.0852	0.0446-0.0809	0.0462-0.0945
p	0.000004	0.00017	0.000001	0.00001
R^2	0.685	0.534	0.747	0.676
Percentage annual increase	5.79	6.06	6.48	7.29
SE	0.880	1.27	0.866	1.16
95% CI	3.87-7.75	3.29-8.89	4.57-8.42	4.73-9.91

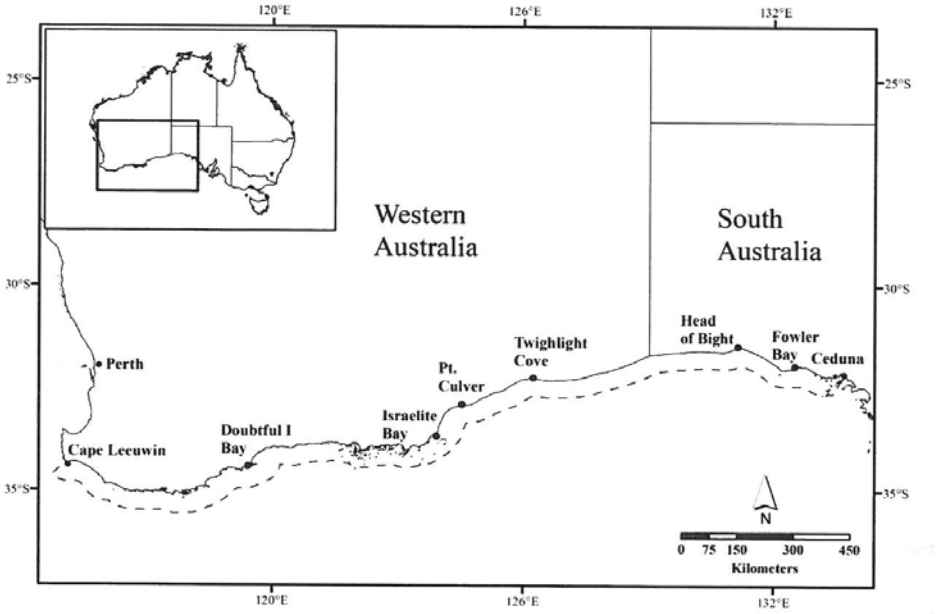
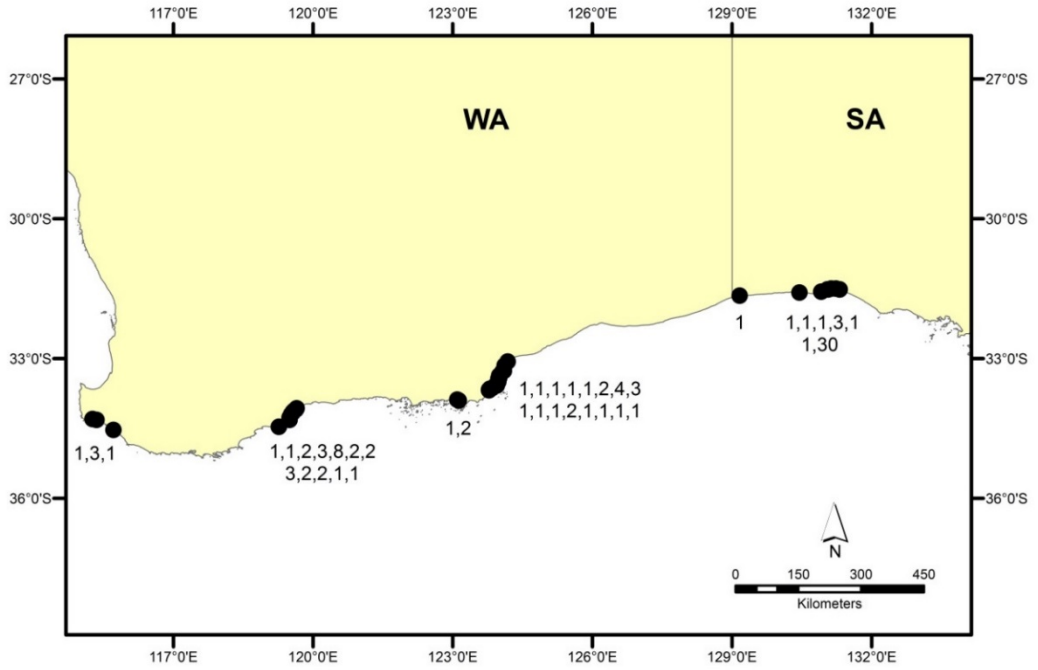


Figure 1: Right whale aerial survey off southern Australia from 1993. Dashed line represents approximate survey route

(a)



(b)

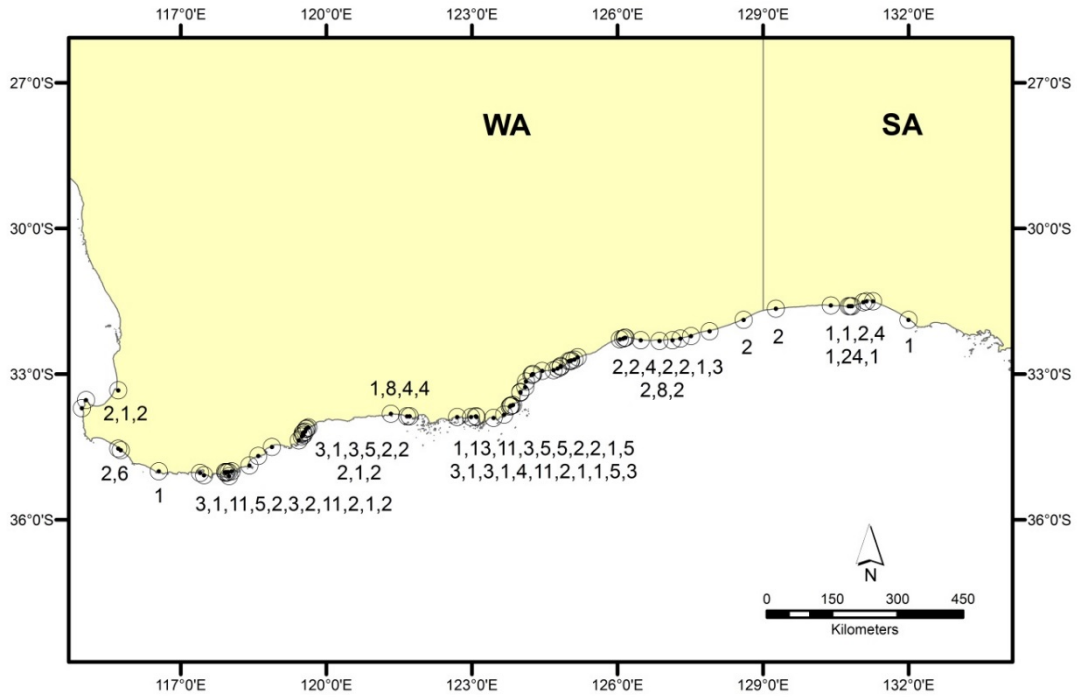
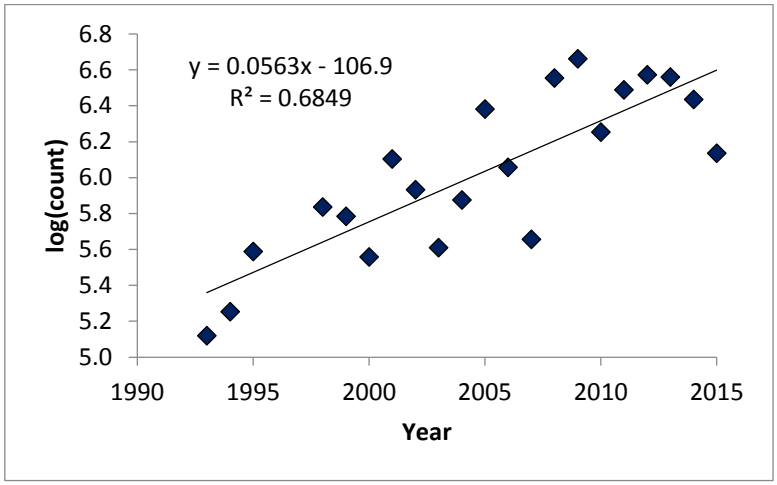


Figure 2: Aerial Survey, WA-SA, 2015. Approximate positions of right whale sightings on the flight and their associated group sizes.

a) Cow-calf pairs (●)
b) Unaccompanied animals (⊙)

(a)



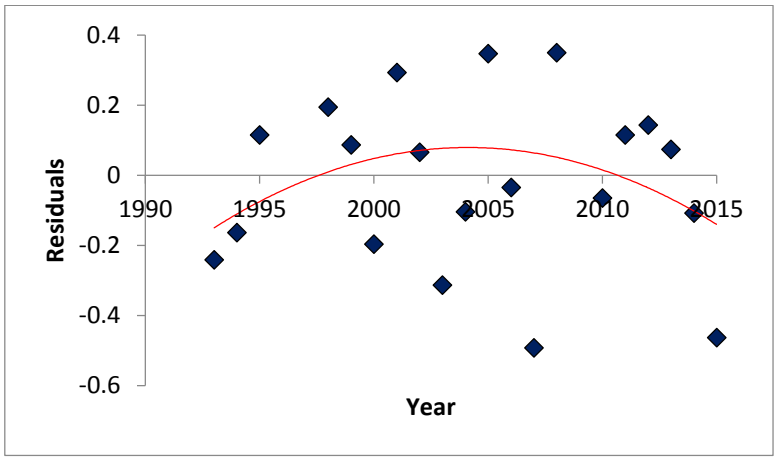
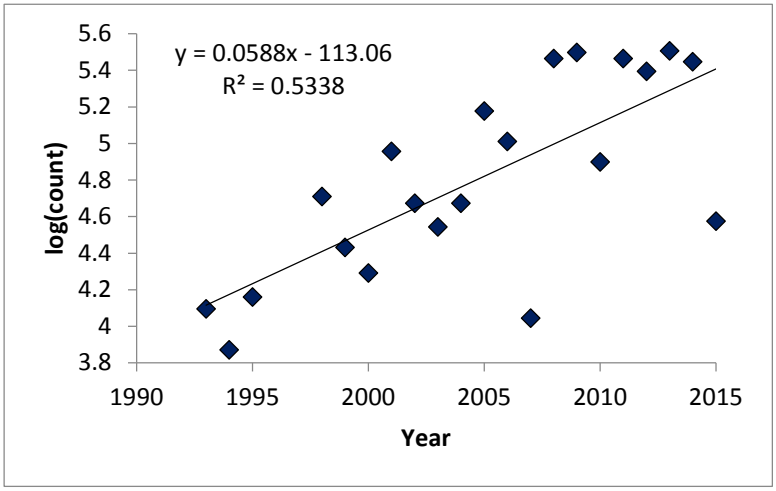
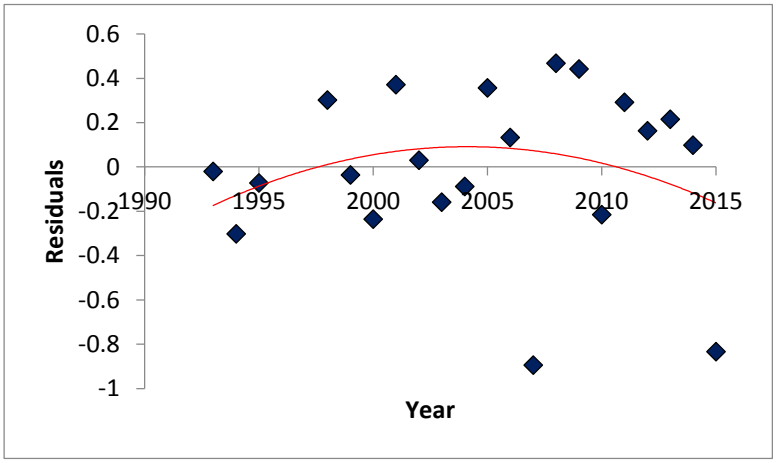


Figure 3: Plots of the fitted linear regression and residuals for the data in Table 2 for 1993-2015, excluding 1996 and 1997. The smooth lines fitted through the residuals shows weak evidence that the exponential growth rate may be slowing.

a) All animals (above)
b) Cow/calf pairs (over page)

(b)


y = 0.0588x - 113.06
R² = 0.5338
log(count)
Year
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
1990
1995
2000
2005
2010
2015


Residuals
Year
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
1990
1995
2000
2005
2010
2015

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