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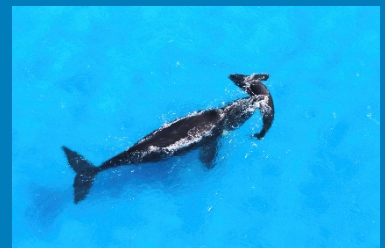
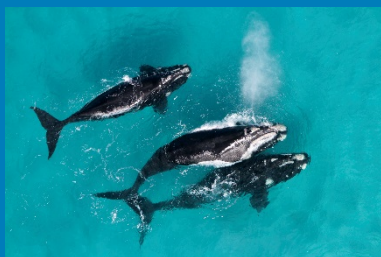
Project A7 - Monitoring Population Dynamics of 'Western' Right Whales off Southern Australia 2015-2018

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FINAL REPORT on activities for 2017

(30 March 2018)

Milestone 6 – Research Plan v3 (2017)



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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, a survey was undertaken over five days, 23-27 August, 2017. A total of 1546 animals was sighted, including 506 calves and 4 'yearlings'; these include double counts, given that each flying leg is covered twice, 'outward' and 'inward'. Additionally 13 humpback whales, including three calves, were recorded (Table 1). For comparison with previous years' results, maximum counts for each leg are taken; for the 2017 survey, the comparable counts are 847 individuals of which 303 were cows accompanied by calves of the year. The 2017 counts are the highest yet in the series.

From 5603 photographic images obtained, 487 have been selected for computer-assisted 'matching' with those (some 9000 images of over 2000 individuals) already available in the catalogue.

Regression analysis of log number against year for 1993-2017 gives increase rates for all animals of 0.0547 (95% CI 0.0392-0.0703) equivalent to a percentage increase of 5.62 (95% CI 4.00-7.28) per annum and for cow/calf pairs of 0.0603 (95% CI 0.0382-0.0824) or 6.22 (3.89-8.59) per annum respectively.

Current population size, for this, the 'western' Australian subpopulation, is estimated at 2474.

A Progress Report on the 2017 survey was provided as required under the funding Agreement, on 31 December 2017.

Further funding, for three years from 2018, is now being provided by the Australian Government through the NESP Marine Biodiversity Hub, Project A7.

1. Introduction

Southern right whales were reduced almost to extinction by 19th Century whaling, throughout the southern hemisphere and including off Australia. Since the mid-1970s, given cessation of whaling on the species, there have been signs of recovery of that part of the population that migrates to the southern Australian coast each year – particularly cows to give birth at approximately three-year intervals, especially off WA and western SA (the ‘western subpopulation’). Since 1976 aerial surveys have been undertaken annually to determine numbers and population trend and obtain individual identifying photographs, at first along the Western Australian south coast from Cape Leeuwin east as far as Twilight Cove, but from 1993 extending into South Australian waters to as far as Ceduna, given 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’.

A Progress Report on the 2017 survey was provided as required under the funding Agreement, on 31 December 2017.

This report summarises the results so far of the planned aerial survey of the ‘western’ subpopulation between Cape Leeuwin and Ceduna in August/September 2017, the third in a series of three funded since 2015 through the NESP marine diversity Hub. It is the final report due by 30 March 2018.

A further three years’ survey, i.e. from 2018-2020, is now being funded by the Australian Government through the NESP Marine Biodiversity Hub, Project A7.

2. Project summary

Aerial Survey, Cape Leeuwin-Ceduna, with an additional leg Augusta-Perth up the west coast, was undertaken successfully between 23 and 27 August 2017.

Extraction of count data was undertaken, as planned, by 30 October. Trend analysis has been undertaken, and is reported here.

An estimate of population size has been obtained, and is reported here.

Photographs taken on the survey have been inspected and those suitable for 'matching' with those already in the 'WA Catalogue' have been selected.

Sighting details have been entered into the database, and forwarded for archiving to The Australian Antarctic Division Archive, Hobart.

3. Aims

- a) continue collection of the dataset, i.e. counts and photographs, of southern right whales, assumed to be from the 'western' Australian subpopulation, 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 of 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.
- c) obtain information on current and past distribution and, in due course, biological parameters such as age at first parturition and calving rate.
- d) continue databasing existing information on sightings, linked to animals already identified.

4. Approach

As in previous years survey was to be undertaken within ca one nautical mile of the coast, 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 photographic 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 (obtained from the maximum count on each 'leg', 'outwards' or 'inwards') was to be compared with results since 1993 to obtain estimates of a) population trend and b) current population size.

The survey methodology involves direct counts of animals observed within the search area. The latter includes virtually all the area to which 'western' right whales resort in winter/spring close to the coast, in particular for the females to give birth, generally at three-year intervals. Most animals, particularly cows accompanied by their calves of the year, are easily observed in the relatively clear waters on the south coast, and the probability of sighting is assumed to be 1. This makes for a relatively simple sighting protocol, repeatable over the years. The most important factor has been to ensure little or no change in pilot- or observer-efficiency, achieved in this case by employing, over as protracted a period as possible, the same charter company (since 1995), pilot/observer (1993-95, 1999-2004, 2006-2013, 2015-2017) and observer/photographer (1998-2015, 2017). Flying is only undertaken on 'good' days, with wind speeds of <15 knots.

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' subpopulation 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.

5. Results

Aerial Survey

Over five 'searching' days, 23-27 August 2017, and over 11 'searching' legs during 38.5 flying hours, there were sightings of 1546 whales, including 506 calves of the year and 4 yearlings, between Perth WA and Ceduna SA. Additionally 13 humpback whales, including three calves, were recorded (Table 1). The figures are of all sightings recorded. For comparison with counts from previous years, only the maximum counts for each leg, 'outwards' or 'inwards', are included; the relevant figures for 2017 are 847, including 241 'unaccompanied' adults and 303 cow/calf pairs (Table 2).

The 2017 comparable counts, for 'all animals' and 'cow calf pairs', at 847 and 303 respectively, were the highest so far in the series (Table 2) compared with previously high counts, of 782 and 715 in 2009 and 2012 respectively for 'all animals', and 244 in 2009 and 246 in 2013 for cow/calf pairs. That for 'unaccompanied' animals in 2017 was not as high as in four previous years (2009, 2010, 2012, 2015), though higher than in 2016.

Trend analysis

Regression analysis of the annual counts of 'all whales' between 1993 and 2017 gives an estimated exponential rate of increase of 0.0547 (95% CI 0.0392, 0.0703) which is equivalent to an annual increase of 5.62% (95% CI 4.00, 7.28), Table 3, Figure 3a. The estimated exponential rate of increase based on counts of cow/calf pairs alone was 0.0603 (0.0382, 0.0824) or an annual increase of 6.22% (3.89, 8.59; see Table 3, Figure 3b).

The inclusion of the counts from the 2017 survey slightly raises the estimate for the rate of increase for this population compared to those estimated from the 1993-2016 data (Table 3). In 2015, (see e.g. Bannister et al 2015) inspection of the residuals of the fitted exponential regressions revealed, for the first time, weak evidence that the growth rate might be starting to slow (Figure 3a). In 2016, the counts were still below the line of best fit driven by the counts from previous years; the weak evidence for a slowdown in growth rate therefore remained. However, it was noted the pattern was strongly influenced by the lower than expected counts in 2015 and it was concluded that exponential increase remained the best description of the data.

In contrast to 2015 and 2016, the high counts in cow/calf pairs 2017 (Table 2, Figure 3b) sit above the line of best fit. These counts therefore undermine the previously noted but weak evidence for a slowing of the growth rate. This result is reflected in the flattened curve in the plot of residuals compared that produced by the 1993-2016 data (Figure 3b).

Two conclusions arise:

1. The population continues to increase by approximately 6% per year (based on counts of cow/calf pairs) although the counts vary greatly and often deviate from those expected from consistent exponential growth.
2. There is now a weaker rationale than before to explore models to test whether the growth rate is slowing down.

Population size

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 (2016) of the three-year period (2015-17), of 2474. The higher figure than in previous years (for 2013-2016 it was 2195) reflects the higher numbers of cow calf pairs observed in 2016 and 2017.

Photography

From 5603 photographic images obtained on the 2017 flight, 487 have been selected for computer-assisted 'matching' with those (some 9000 images of over 2000 individuals) already available in the 'WA catalogue'.

Current distribution

As in past years the 2017 flights recorded concentrations of particular classes of animals at various locations along the coast. As usual, 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), west of Cape Arid, and along the coast to the north east of Israelite Bay (all in WA), and at Head of Bight (SA) (Figure 2a). 'Unaccompanied' animals, mostly adults but with no associated calves, were as usual found in much the same places, but rather more widely along the coast (Figure 2b), and with relatively very few at Head of Bight. On the 2017 outward leg, between Caiguna (WA) and Nullarbor (SA) there was a noticeable lack of 'unaccompanied' animal sightings either side of the WA/SA border; in 2016 a noticeable feature was a concentration of that class near Eucla, in contrast to 2015 where they were spread further along the coast to the west. In 2017 there were also relatively large numbers, of cow/calf pairs and 'unaccompanied' animals, at Fowler Bay, east of Head of Bight, SA.

Databasing

For 2017, 119 data sightings sheets have been added to the sightings database, currently totalling 3860 sheets, of which 3273 relate to the period 1993-2017.

Data archiving

Previous count data, sightings and individual whale sheets have been submitted to the Australasian Right Whale Photo-identification Catalogue (ARWPIC) hosted by the Australian Marine Mammal Centre and Australian Antarctic Data Centre at the Australian Antarctic Division, archived at the Australian Antarctic Division Archives, Hobart. Those from 2017 have been forwarded to that archive.

The data will facilitate a planned, and now to be funded, mark-recapture analysis of life-history parameters, population connectivity and individual movements as well as population abundance and trend. They will inform an assessment of the current conservation status of Australian right whales and their recovery relative to their pre-whaling abundance.

6. ACKNOWLEDGEMENTS

Jenny Schmidt (flying for Great Southern Aviation, Albany, WA) piloted the flight, with Adam Halsalli (Andrew Halsall Photography) as observer/photographer: their hard work and dedication are acknowledged. Dr Josh Smith (Murdoch University) produced Figures 1 and 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, trend analysis, and allied matters. Dr Claire Charlton (Curtin University) provided information on the situation at Head of Bight (SA).

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.

The flying was undertaken under relevant permits from the WA Department of Biodiversity, Conservation and Attractions (DBCA) and the SA Department of Environment, Water and Natural Resources (DEWNR).

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TABLES AND FIGURES

Table 1. Right whale aerial survey C. Leeuwin WA-Ceduna SA, 2017. Summary of results.

Flight	Date	Leg	Whale sightings								Weather ¹	Flying hrs
			Right whales				Other large whales ²					
			A ³	C	Y	T	A	C	Y	T		
Outward legs, from Albany	23/08 /17	1. Albany- Bremer Bay*	117	77	0	194	4	2	0	6	07/06	3.9
	23/08	2. Bremer Bay- Esperance*	0	0	0	0	0	0	0	0	00/00	6.7
“	24/08	3. Espera- nce-Caiguna	220	101	2	323	0	0	0	0		
“	24/08	4a. Caiguna- Nullarbor (incl Head of Bight)	127	57	0	184	0	0	0	0	08	6.45
	25/08	4b. Nullarbor- Point Bell (=Ceduna)	35	17	0	52	0	0	0	0		
Total Outward		1-4. Albany- Pt Bell (Ceduna)	499	252	2	753	4	2	0	6		17.05
Inward legs from Point Bell (Ceduna)	25/08	5. Point Bell- Nullarbor (incl Head of Bight)*	123	95	0	218	0	0	0	0	08	2.25
	25/08	6. Nullarbor- Caiguna (excl Head of Bight)*	76	12	0	88	0	0	0	0	10	3.7
	26/08	7. Caiguna- Esperance*	227	119	1	347	0	0	0	0	8	4.7
	26/08	8. Esperance- Albany	91	26	1	118	0	0	0	0	10	3.7
	27/08	9. Albany – Augusta*	19	2	0	21	1	1	0	2	12	2.17
Total Inward		5-9. Pt Bell (Ceduna) - Augusta	536	254	2	792	1	1	0	2		16.52

¹ as indicated by wind speed, knots

² all humpbacks; no other large whales recorded

³ A=adult, C=calf, Y='yearling', T=total

* legs with maximum numbers used in mapping and calculating trend, i.e. in Table 2

Flight	Date	Leg	Whale sightings								Weather ⁴	Flying hrs
			Right whales				Other large whales ⁵					
			A ⁶	C	Y	T	A	C	Y	T		
<i>Additional legs</i>	27/08	10. Augusta-Perth (Jandakot)	1	0	0	1	5	0	0	5	12/18	2.63
	27/08	11. Jandakot-Albany	-	-	-	-	-	-	-	-	12/08	2.3
Total 2017	5 days	11 legs	1036	506	4	1546 incl 506 calves, 4 yearlings	10	3	0	13 incl 3 calves		38.5

⁴ as indicated by wind speed, knots

⁵ all humpbacks; no other large whales recorded

⁶ A=adult, C=calf, Y='yearling', T=total

* legs with maximum numbers used in mapping and calculating trend, i.e. in Table 2

Table 2. Right whale aerial survey C. Leeuwin WA-Ceduna SA. Comparable sightings since 1993

Year	a. All animals	b. 'Unaccompanied' animals	c. Cow/calf pairs
1993	167	47	60
1994	191	95	48
1995	267	139	64
1996	233	123	55
1997	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
2016	628	172	228
2017	847	241	303

⁷ 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	1993-2017		1993-2016	
Class	All animals	Cow/calf pairs	All animals	Cow/calf pairs
Exponential increase	0.0547	0.0603	0.0541	0.0584
SE	0.0075	0.0106	0.0081	0.0116
95% CI	0.0392-0.0703	0.0382-0.0824	0.0371-0.0710	0.0343-0.0824
p	0.0000003	0.000013	0.000002	0.00006
R ²	0.719	0.605	0.689	0.562
Percentage annual increase	5.62	6.22	5.55	6.01
SE	0.750	1.07	0.816	1.16
95% CI	4.00-7.28	3.89-8.59	3.78-7.36	3.49-8.59

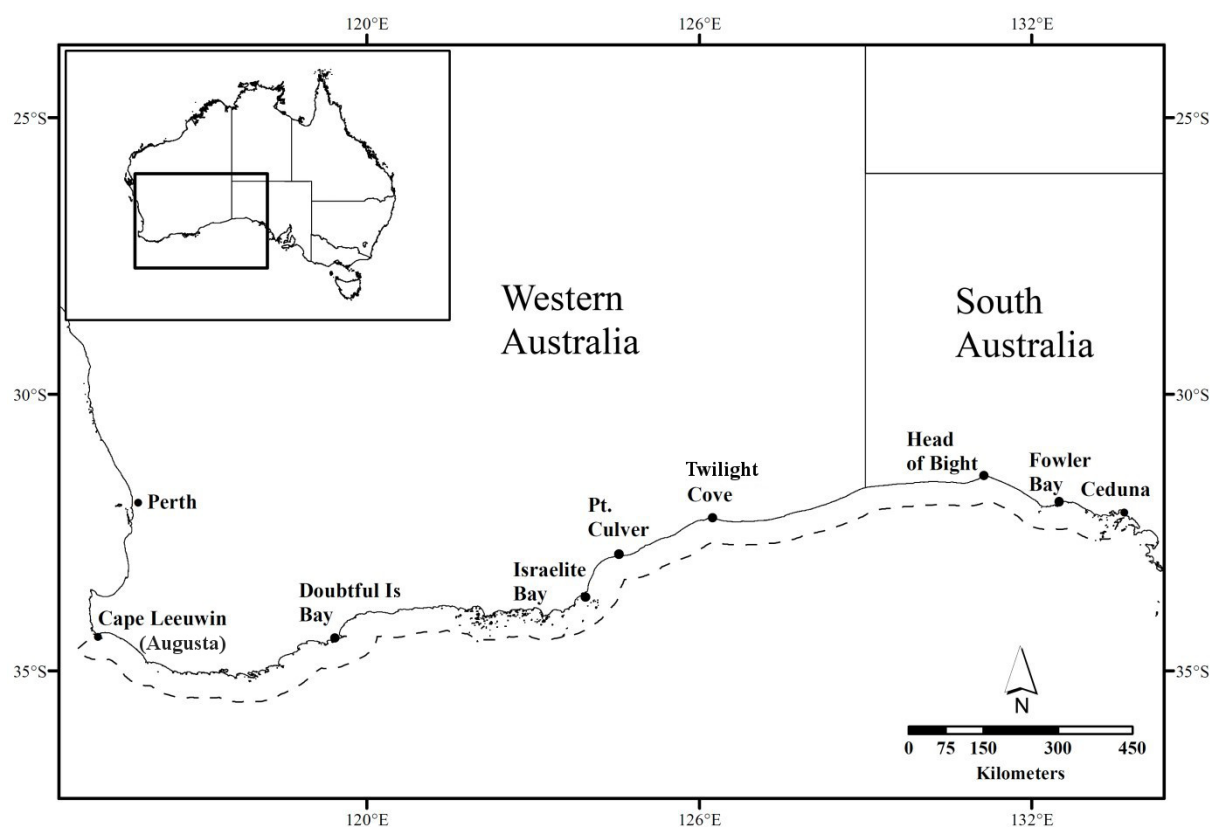


Figure 1. Right whale aerial survey off southern Australia to 2017. Dashed line represents approximate survey area

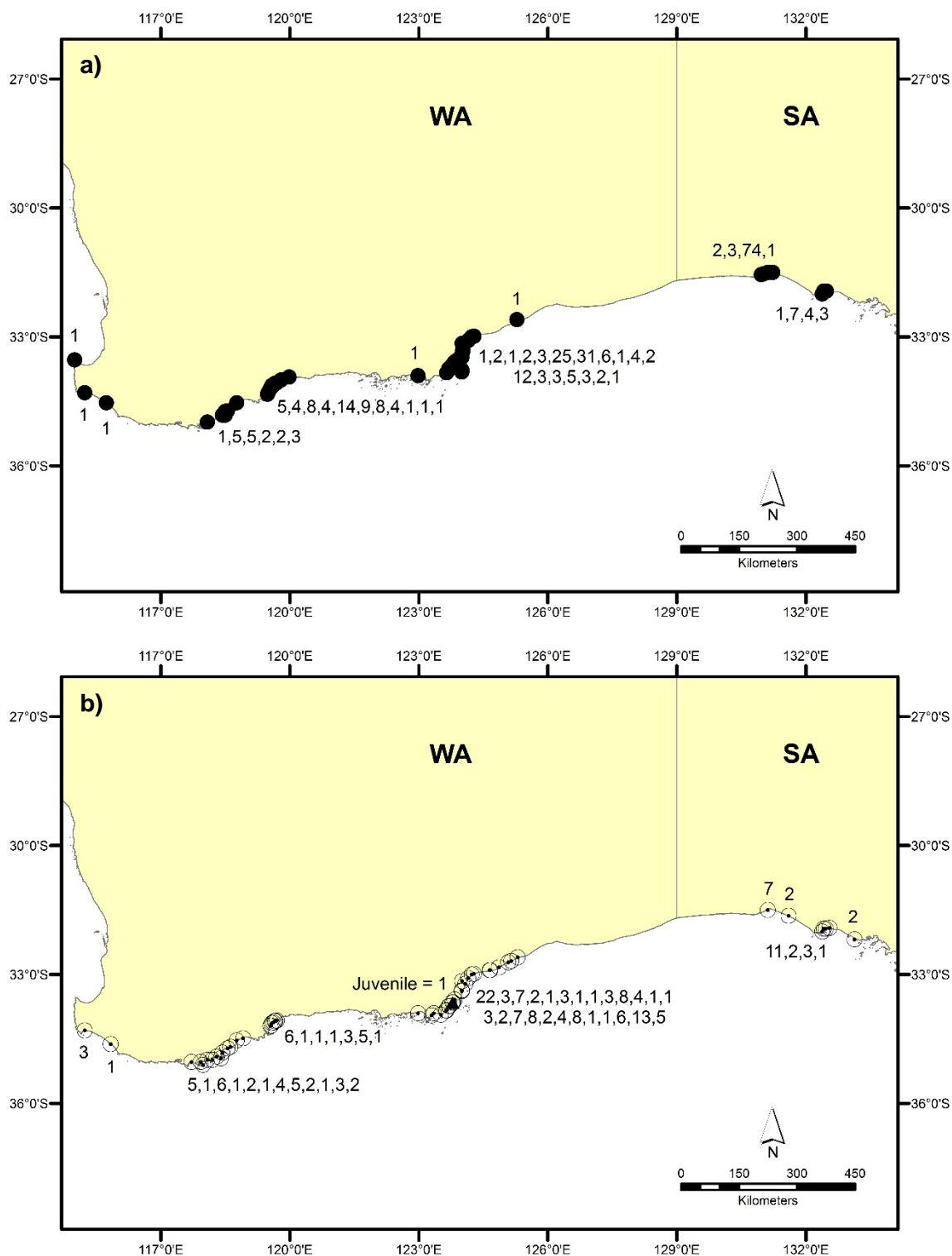


Figure 2. Aerial Survey, WA-SA, 2017. Approximate positions of right whale sightings on the flight and their associated group sizes.

a) Cow-calf pairs (●)

b) Unaccompanied animals (○) and Juvenile (▲)

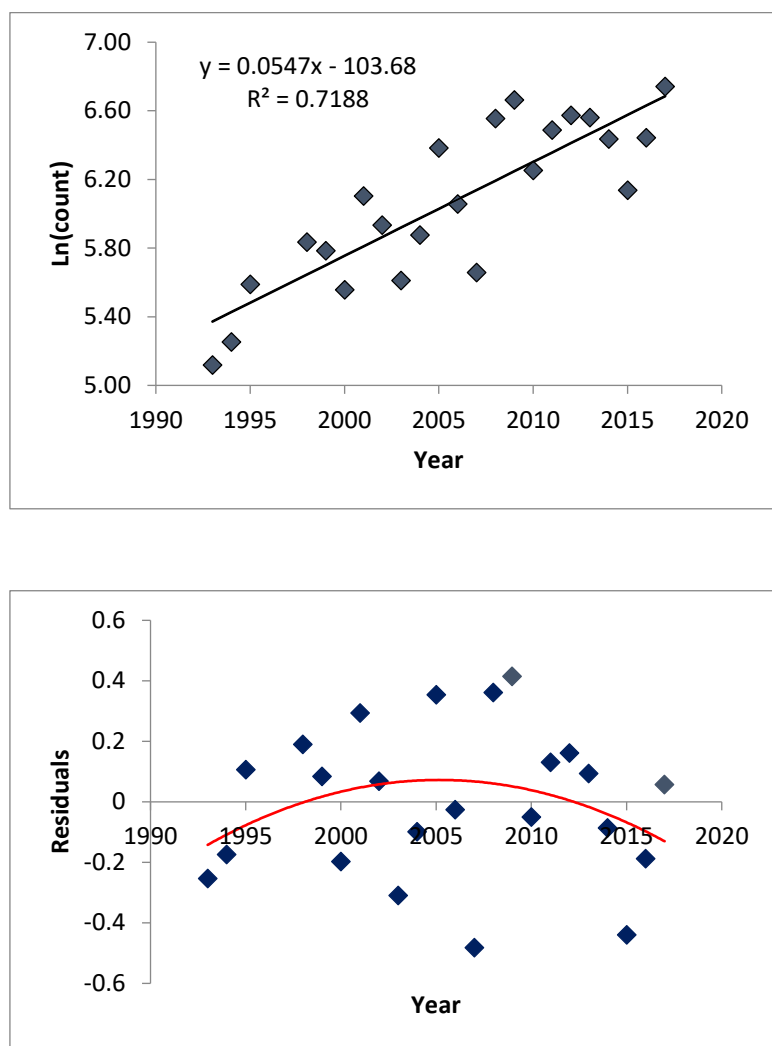


Figure 3a. Plots of the fitted linear regression and residuals for the data in Table 2 for 1993-2017, excluding 1996 and 1997 - *All animals*.

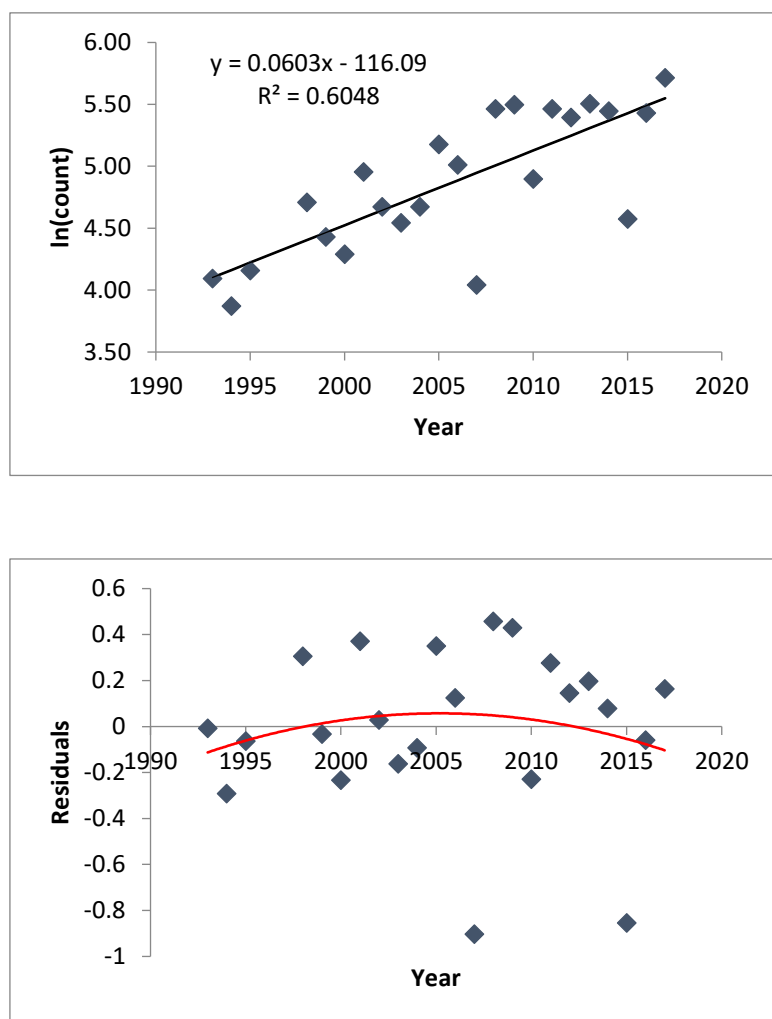


Figure 3b. Plots of the fitted linear regression and residuals for the data in Table 2 for 1993-2017, excluding 1996 and 1997 - *Cow/calf pairs*.



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