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A Review of the Distribution of Seals in South Australia

S.D. Goldsworthy & B. Page

June 2009

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Report to the Department of the Environment, Water, Heritage and the Arts

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1. EXECUTIVE SUMMARY

This report reviews data from the Department of Environment, Water, Heritage and the Arts on the distribution of seals in South Australia. This report amends the DEWHA maps of the distribution of seals in South Australia and their associated attribute tables. The report includes spreadsheets of the locations of seal breeding colonies and estimates of the sizes of colonies. Where appropriate, the report includes caveats with the data, to give users an indication of how the colony locations and foraging distributions were determined (eg surveys, literature reviews, satellite tracking, biological models).

2. INTRODUCTION

During September 2008, SARDI provided the Department of Environment, Water, Heritage and the Arts (DEWHA) with information on biologically important areas (breeding colonies and at-sea distributions) for seals in SA. This information was digitised and provided to SARDI in a package that also contained copies of the original, hand-drawn maps and attribute information.

The DEWHA intend to publish some of the information in the Draft South-West Marine Bioregional Plan, and to make the information available on the Department's species information database, which is publicly available. In addition, DEWHA intend to make the information available on request to assist other parties involved in marine planning including state governments and non-government agencies.

3. AIMS AND OBJECTIVES

This report details the abundance of Australian sea lions, New Zealand fur seals and Australian fur seals at breeding sites in South Australia.

The aims of this report are to:

- Review DEWHA data on the distribution of seals in South Australia;
- Amend the DEWHA maps of the distribution of seals in South Australia and the associated attribute tables;
- Provide spreadsheets of the locations of seal breeding colonies and estimates on the sizes of colonies; and
- Provide caveats that should be included with the data to give users an indication of how the colony locations and foraging distributions were determined (eg surveys, literature reviews, satellite tracking, biological models).

This report does not include data on the abundance or at-sea movements of Australian sea lions, NZ fur seals or Australian fur seals from haulout sites.

4. MATERIALS AND METHODS

South Australian Research and Development Institute (SARDI) staff reviewed the maps on the distribution of seals in South Australia, which were provided by DEWHA. Amendments to these data are provided below.

The maps provided by DEWHA contained caveats, which related to the reliability of the data (eg, whether the data were obtained via satellite tracking, biological models, surveys, literature reviews). These data were reviewed and amended as required.

5. RESULTS AND DISCUSSION

5.1 Australian sea lion breeding sites

The review of data on the distribution of Australian sea lion breeding sites in South Australia, which was provided by DEWHA, indicated that: 1) DEWHA did not have a complete list of the known breeding sites for the Australian sea lion in South Australia; 2) some of the Australian sea lion breeding sites provided by DEWHA were in the wrong locations; and 3) some of the Australian sea lion breeding sites provided by DEWHA were duplicated in their database. No data on the abundance of Australian sea lions in South Australia were provided by DEWHA.

Instead of correcting each of the errors in the DEWHA database, we have provided the locations of known breeding sites for the Australian sea lion in South Australia in this report (Figure 1 and Table 1). These data are provided for breeding sites and for sites regarded as haulout sites with occasional pupping (Figure 1 and Table 1). These data also contain information on the numbers of times that each breeding site has been surveyed, the ranges of pups counted, the year of the most recent survey, the method employed for the most recent survey, the pup count from the most recent survey and the source of the pup count data (Figure 1 and Table 1). The data contained in this report can be copied and used in GIS or the data can be provided in .txt, .xls, or other formats, on request. Google Earth files of breeding sites (.kml) are also provided in this report.

Figure 1. The locations of known breeding sites for the Australian sea lion in South Australia.

Table 1. The locations of known breeding sites for the Australian sea lion in South Australia and the range of pup counts between 1985-2008.

Locations are given in decimal degrees. Local names are noted by quotation marks. The year and method used for the most recent pup count for each location are given. For detail of the classification of survey methods refer to Goldsworthy et al. (2009a). Methods range in decreasing order of accuracy from: 1 (most accurate) to 4 (highly inaccurate). 'UK' indicates timing of breeding season unknown. Sources of pup count data are: (1) Shaughnessy (2005b), Shaughnessy and Goldsworthy (2007), (2) Goldsworthy et al. (2008a), (3) Goldsworthy et al. (2008b), (4) Gales et al. (1994), (5) Goldsworthy et al. (in review), (6) Goldsworthy et al. (2007b), (7) Shaughnessy et al. (2005), (8) Robinson et al. (2008), (9) Dennis (2005), (10) Shaughnessy (2005a), (11) Shaughnessy (2008), (12) Goldsworthy et al. (2007a), (13) S. Goldsworthy (unpublished data), (14) Goldsworthy et al. (2003), (15) Campbell and Gales (unpublished), (16) Shaughnessy et al. (in press), (17) Dennis and Shaughnessy (1996), (18) Dennis and Shaughnessy (1999), (19) N. Gales (unpublished data), Goldsworthy et al. (2009b).

Location	Lat	Long	No. of surveys	Pup range	Most recent survey	Method	Pup count	Reference	Type	Notes
North Pages Island	-35.7590	138.3011	13	177-312	2005	1	258	1	Breeding	
South Pages Island	-35.7771	138.2917	13	197-331	2005	1	331	1	Breeding	
'Seal Slide' (Kangaroo Is)	-36.0257	137.5361	11	1-16	2007	1	16	2	Breeding	
Seal Bay (Kangaroo Is)	-35.9950	137.3170	16	122-260	2007	1	260	3	Breeding	
Peaked Rocks-west	-35.1850	136.4820	2	15-24	1990	3	24	4	Breeding	Data combined for east and west Peaked Rocks
Peaked Rocks-east	-35.1810	136.4920						See notes	Breeding	Data combined for east and west Peaked Rocks
North Islet	-35.1207	136.4761	3	1-28	2005	3	28	5	Breeding	
Dangerous Reef	-34.8150	136.2120	11	248-709	2007	1	709	6	Breeding	
English Island	-34.6379	136.1958	6	4-27	2005	2	27	5	Breeding	
Albatross Island	-35.0686	136.1814	2	12-15	2005	4	15	5	Breeding	
South Neptune (Main) Islands	-35.3303	136.1118	6	0-6	2008	3	6	13	Breeding	
North Neptune - East Island	-35.2280	136.0770	2	11-14	2005	3	14	5	Breeding	
Lewis Island	-34.9570	136.0317	2	78-131	2007	1	131	2	Breeding	
Liguanea Island	-34.9984	135.6199	3	1-43	2004	2	43	5	Breeding	
Price Island	-34.7076	135.2895	1	-	1996	3	25	7	Breeding	
Rocky Island (North)	-34.2587	135.2605	1	-	1996	3	16	7	Breeding	
Four Hummocks (North) Island	-34.7577	135.0421	1	-	1996	3	12	7	Breeding	
West Waldegrave Island	-33.5962	134.7615	4	79-157	2003	2	157	7	Breeding	

Table 1. continued.

Location	Lat	Long	No. of surveys	Pup range	Most recent survey	Method	Pup count	Reference	Type	Notes
Jones Island	-33.1853	134.3671	7	5-15	2007	1	15	2	Breeding	
Ward Island	-33.7409	134.2850	3	2-45	2006	3	45	8	Breeding	
Pearson Island	-33.9620	134.2670	7	1-35	2005	3	35	9	Breeding	
Point Labatt	-33.1523	134.2607	8	1-6	2005	4	6	10	Breeding	
Nicolas Baudin Island	-33.0157	134.1330	5	49-98	2006	2	98	11	Breeding	
Olive Island	-32.7191	133.9698	8	12-206	2006	1	206	12	Breeding	
Lilliput Island	-32.4340	133.6930	3	46-67	2005	1	67	5	Breeding	
Blefuscu Island	-32.4670	133.6440	3	75-84	2005	1	84	5	Breeding	
Gliddon Reef	-32.3220	133.5610	2	7	2005	3	7	5	Breeding	
Breakwater Island	-32.3160	133.5300	4	6-17	2005	1	17	5	Breeding	
Lounds Island	-32.2730	133.3657	4	4-34	2008	3	34	20	Breeding	
Fenelon Island	-32.5810	133.2817	5	10-40	2008	3	40	20	Breeding	
West Island	-32.5108	133.2513	3	14-56	2005	2	56	5	Breeding	
Purdie Island	-32.2698	133.2284	5	34-132	2005	3	132	5	Breeding	
Nuyts Reef (west)	-32.1186	132.1314	2	-	2004	3	12	7	Breeding	
‘Bunda Cliffs B1’	-31.5175	131.0611	2	11-15	1995	3	15	14	Breeding	
‘Bunda Cliffs B2’	-31.5862	130.5808	3	1-5	1995	4	5	14	Breeding	
‘Bunda Cliffs B3’	-31.5823	130.1259	4	5-31	1995	4	31	14	Breeding	
‘Bunda Cliffs B5’	-31.5851	130.0306	3	1-43	1995	4	43	14	Breeding	
‘Bunda Cliffs B6’	-31.6094	129.7618	3	3-12	1995	4	12	14	Breeding	
‘Bunda Cliffs B8’	-31.6396	129.3810	3	2-38	1995	4	38	14	Breeding	
‘Bunda Cliffs B9’	-31.6467	129.3114	2	7-17	1995	4	17	14	Breeding	

Table 1. continued.

Location	Lat	Long	No. of surveys	Pup range	Most recent survey	Method	Pup count	Reference	Type	Notes
Black Point	-36.0382	137.4063	2	1-1	2002	4	1	16	Occasional pupping	
Cave Point	-36.0258	136.9574	2	1-3	1990	3	3	16	Occasional pupping	
Cape Bouguer	-36.0416	136.9088	6	0-3	1999	3	3	16	Occasional pupping	
North Casuarina Island	-36.0682	136.7025	4	1-3	1996	3	3	16	Occasional pupping	
Dorothee Island	-34.0050	134.2450	2	-	1996	3	1	7	Occasional pupping	
Point Fowler (‘Camel-foot Bay’)	-32.0108	132.4378	1	-	1994	3	1	17	Occasional pupping	
Nuyts Reef (middle)	-32.1386	132.1414	2	-	1990	3	3	4	Occasional pupping	
‘Bunda Cliffs B4’	-31.5856	130.0611	2		1995	4	2	14	Occasional pupping	
‘Bunda Cliffs B7’	-31.6250	129.5105	UK		1994	4	3	14	Occasional pupping	

5.2 New Zealand fur seal breeding sites

Data on the abundance of New Zealand fur seals in South Australia were provided by DEWHA. These data contained counts of NZ fur seal pups at some sites (eg the Neptune Islands), and/or NZ fur seal non-pups at other sites (eg many non-breeding colonies or haulout sites), but no distinctions were made between the different methods. Pups are counted at breeding colonies because pups are the only demographic group that remains ashore, and can therefore be reliably counted. Pup count data can be used to estimate the number of non-pups in seal populations (Goldsworthy et al. 2003). Counts of non-pups at non-breeding sites do not account for the number of seals that may use a haulout, but are at-sea during the survey. Counts at haulout sites may provide indices of relative abundance across a region, but there have not been any state-wide surveys of NZ fur seal haulout sites that can be summarised in this report. This report therefore only summarises the breeding sites of the NZ fur seal in South Australia.

The review of the data provided by DEWHA indicated that: 1) DEWHA did not have a complete list of the known breeding sites for the NZ fur seal in South Australia; 2) some of the NZ fur seal breeding sites provided by DEWHA were in the wrong location; and 3) some of the NZ fur seal breeding sites provided by DEWHA were duplicated in their database.

Instead of correcting each of the errors in the DEWHA database, we have provided the locations of known breeding sites for the NZ fur seal in South Australia in this report (Figure 2 and Table 2). These data are provided for all sites where NZ fur seal pups have been recorded in South Australia (Figure 2 and Table 2). These data also contain information on the month of the most recent survey, the pup count from the most recent survey and the source of the pup count data (Figure 2 and Table 2). The data contained in this report can be copied and used in GIS or the data can be provided in .txt, .xls, or other formats, on request. Google Earth files of breeding sites (.kml) are also provided in this report.

Figure 2. The locations of known breeding sites for the NZ fur seal in South Australia.

Table 2. The locations of known breeding sites for the NZ fur seal in South Australia and the pup counts from the most recent survey.

Locations are given in decimal degrees. The month of the most recent survey and the most recent pup count for each location are given. Further details on the survey methods can be found in the reports/papers that are referenced in this table.

Location	Lat	Long	Pup count	Most recent survey	Reference
Baudin Rocks	-37.0860	139.7236	3	May 07	SARDI unpublished data
Cape Hart	-35.9000	138.0480	2	Feb 08	Shaughnessy (2008)
Cape Linois	-36.0200	137.5860	3	Mar 08	Shaughnessy (2008)
Berris Pt	-36.0520	137.5060	1110	Jan 09	Shaughnessy (2009)
Little Weirs & nearby	-36.0625	137.4810	7	Jan 08	Shaughnessy (2008)
Cape Gantheaume	-36.0750	137.4600	3337	Jan 09	Shaughnessy (2009)
Cape Gantheaume, w beach	-36.0630	137.4500	13	Jan 08	Shaughnessy (2008)
Xenolith Point	-36.0240	136.9770	1	Feb 07	Shaughnessy and Goldsworthy (2007)
Cave Point	-36.0258	136.9574	30	Feb 07	Shaughnessy and Goldsworthy (2007)
Horseshoe Bay points	-36.0380	136.9280	3	Feb 06	Shaughnessy (2006)
Cape Bouguer	-36.0258	136.9574	17	Feb 06	Shaughnessy (2006)
Knife & Steel Point	-36.0470	136.7230	148	Feb 08	Shaughnessy (2008)
Weirs Cove north	-36.0540	136.7180	171	Feb 08	Shaughnessy (2008)
Weirs Cove south	-36.0550	136.7190	85	Feb 08	Shaughnessy (2008)
Ladders North	-36.0580	136.7070	257	Jan 98	Shaughnessy (1998)
Ladders South	-36.0590	136.7070	21	Jan 98	Shaughnessy (1998)
Admirals Arch	-36.0633	136.7046	13	Jan 08	Shaughnessy (2008)
North Casuarina Is.	-36.0682	136.7025	221	Feb 08	Shaughnessy (2008)
Nautilus Rock	-36.0546	136.6968	118	Feb 08	Shaughnessy (2008)

Table 2. continued.

Location	Lat	Long	Pup count	Most recent survey	Reference
Nautilus North	-36.0544	136.7000	392	Feb 08	Shaughnessy (2008)
Libke	-36.0500	136.7065	733	Feb 08	Shaughnessy (2008)
Spooks North	-36.0450	136.7057	407	Feb 08	Shaughnessy (2008)
South Neptune, Main	-35.3303	136.1118	3324	Feb 08	SARDI unpublished data
South Neptune, Middle	-35.3350	136.1120	124	Feb 08	SARDI unpublished data
South Neptune, Lighthouse	-35.3360	136.1230	61	Feb 08	SARDI unpublished data
North Neptune, west	-35.2330	136.0670	3575	Feb 08	SARDI unpublished data
North Neptune, east	-35.2280	136.0770	164	Feb 08	SARDI unpublished data
Liguanea Island	-34.9984	135.6199	1776	Feb 08	SARDI unpublished data
Rocky (South) Is	-34.8170	134.7000	50	Jan 96	Shaughnessy et al. (2005)
Little Hummock Is	-34.7500	135.0830	7	Jan 90	Shaughnessy et al. (1994)
Four Hummocks Is	-34.7670	135.0330	57	Jan 96	Shaughnessy et al. (2005)
Greenly Is	-34.6400	134.7930	7	Jan 04	B. Page, in Shaughnessy et al. 2005
Dorothee Is	-34.0050	134.2450	2	Jan 05	Shaughnessy et al. (2005)
Pearson Is.	-33.9620	134.2670	17	Feb 08	summarised in Shaughnessy (2008)
Ward Island	-33.7409	134.2850	64	Jan 90	Shaughnessy et al. (1994)
West Waldegrave Is.	-33.5962	134.7615	1	Feb 04	Shaughnessy et al. (2005)
Nicolas Baudin Is.	-33.0157	134.1330	2	Jun 07	Shaughnessy and Goldsworthy (2007)
Olive Is.	-32.7191	133.9698	1	Mar 06	Shaughnessy (2006)
Fenelon Is.	-32.5810	133.2817	1	Mar 05	Shaughnessy (2005b)
Nuyts Reef	-32.1386	132.1414	1	Apr 04	Shaughnessy et al. (2005)

5.3 Australian fur seal breeding site

Data on haulout sites used by Australian fur seals in South Australia were provided by DEWHA. These data are records of locations where at least one Australian fur seal has been reported on an island. Seal pups are counted at breeding colonies because pups are the only demographic group that remains ashore, and can therefore be reliably counted. Pup count data can be used to estimate the number of non-pups in seal populations (refer Goldsworthy et al. 2003). Counts of non-pups at non-breeding sites do not account for the number of seals that may use a haulout, but are at-sea during the survey. Counts at haulout sites may provide indices of relative abundance across a region, but there have not been any state-wide surveys of Australian fur seal haulout sites that can be summarised in this report. This report therefore only presents information on the single breeding site of the Australian fur seal in South Australia.

We have provided the location of known breeding site for the Australian fur seal in South Australia in this report (Figure 3 and Table 3). These data also contain information on the month of the most recent survey, the pup count from the most recent survey, and the source of the pup count data (Figure 3 and Table 3). The data contained in this report can be copied and used in GIS or the data can be provided in .txt, .xls, or other formats, on request. Google Earth files of breeding sites (.kml) are also provided in this report.

Figure 3. The location of the known breeding site for the Australian fur seal in South Australia.

Table 3. Known breeding site for the Australian sea fur seal in South Australia and the most recent pup count.

Location	Lat	Long	Pup count	Most recent survey	Reference
North Casuarina Is.	-36.068	136.703	28	Jan 2008	Shaughnessy and Goldsworthy (2007), Shaughnessy (2008)

5.4 At-sea distribution of Australian sea lions

A map of the at-sea distribution of Australian sea lions in South Australia was provided by DEWHA. The map highlighted regions used by adult male and adult female sea lions as their "known biologically important areas".

Based on our unpublished satellite tracking data from more than 150 adult females, 20 adult males and 25 juvenile Australian sea lions from 15 locations in South Australia, these maps provide a reasonable interpretation of the at-sea distribution of adult male and adult female Australian sea lions in South Australia.

The "ecological reason for use" for adult males should read "adult males use the entire continental shelf, where they overlap with adult females, but adult males also forage in deeper waters, further out to sea".

If DEWHA wanted to include a note on the at-sea distribution for juvenile Australian sea lions, an "other comment" could be included in the adult female row. The comment would be, "the at-sea distribution of juvenile Australian sea lions forms a subset of the space used by adult female Australian sea lions".

The at-sea distribution of adult male, adult female and juvenile Australian sea lions is currently being modelled and these model outputs will be available in late 2009, as part of a FRDC/DEWHA funded project. Published data on the foraging behaviour of Australian sea lions can also be found in Fowler et al. (2006).

5.5 At-sea distribution of adult male New Zealand fur seals

No data were provided by DEWHA on the at-sea distribution of adult male NZ fur seals in South Australia.

Based on the results of Goldsworthy et al. (2003), Page et al. (2006) and Page and Goldsworthy (unpublished data), we have estimated the at-sea distribution of adult male NZ fur seals in South Australia (Figure 4). This map will be provided to DEWHA as MapInfo files, or other formats, on request (this layer will need to be land-clipped).

Habitat category: foraging

Certainty of occurrence: known to occur

Level of use: high

Season of use: year round

Ecological reason for use: adult males use the entire continental shelf, where they overlap with adult females, but adult males also forage in deeper waters over the continental shelf slope.

Source description: Kangaroo Island: Page et al. (2006), Donington Reef: Page and Goldsworthy (unpublished data). Other colonies/regions: extrapolated from satellite tracking data from other sites (Goldsworthy et al. 2003).

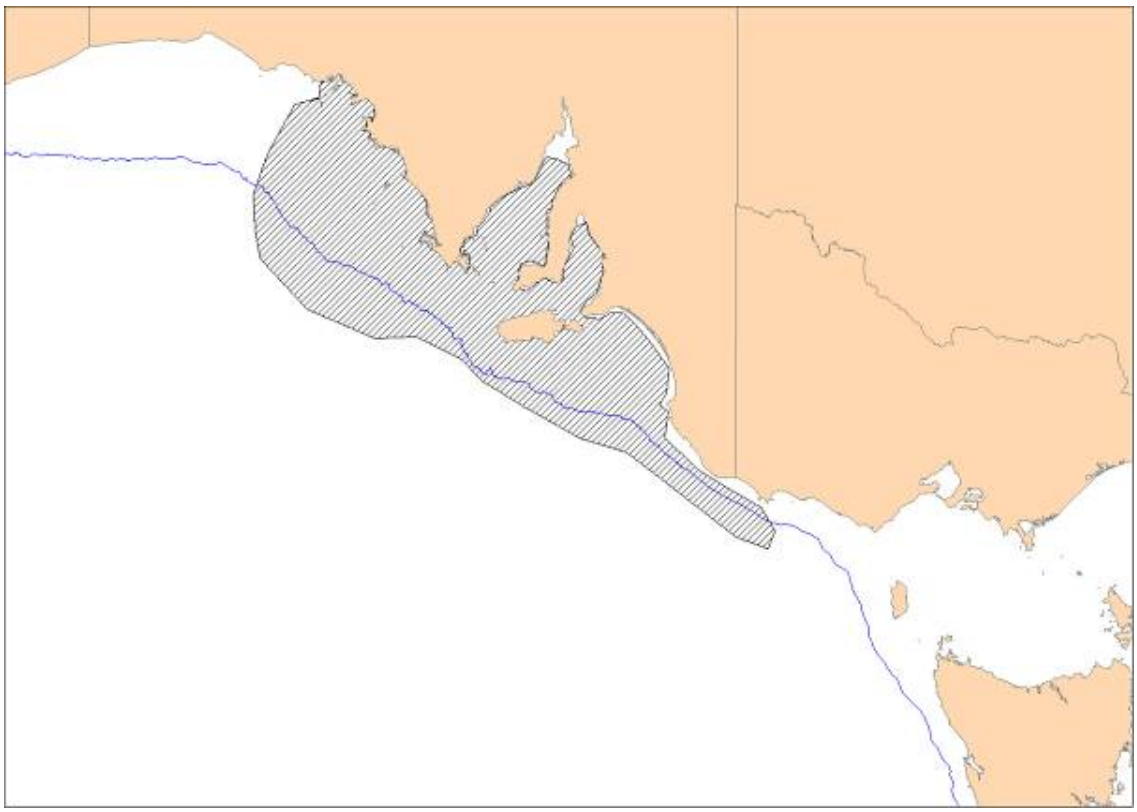

Figure 4. Estimated at-sea distribution of adult male NZ fur seals in South Australia.

5.6 At-sea distribution of adult female New Zealand fur seals

No data were provided by DEWHA on the at-sea distribution of adult female NZ fur seals in South Australia.

Based on the results of Goldsworthy et al. (2003), Page et al. (2006), and Baylis et al. (2008), we have estimated the at-sea distribution of adult female NZ fur seals in South Australia (Figure 5). This map will be provided to DEWHA as MapInfo files, or other formats, on request (this layer will need to be land-clipped).

Habitat category: foraging

Certainty of occurrence: known to occur

Level of use: high

Season of use: year round

Ecological reason for use: In summer and autumn, most adult females use the entire continental shelf, where they overlap with adult males, but adult males also forage in deeper waters over the continental shelf slope. During summer and autumn, some adult females use pelagic waters that are associated with the sub-tropical front, between 600-1000 km south of the continental shelf break. In winter and spring, an increasing proportion of adult females use pelagic waters.

Source description: Kangaroo Island: Page et al. (2006), Neptune and Liguanea Island: Baylis et al. (2008) and Page and Goldsworthy (unpublished data). Other colonies/regions: extrapolated from satellite tracking data from other sites (Goldsworthy et al. 2003).

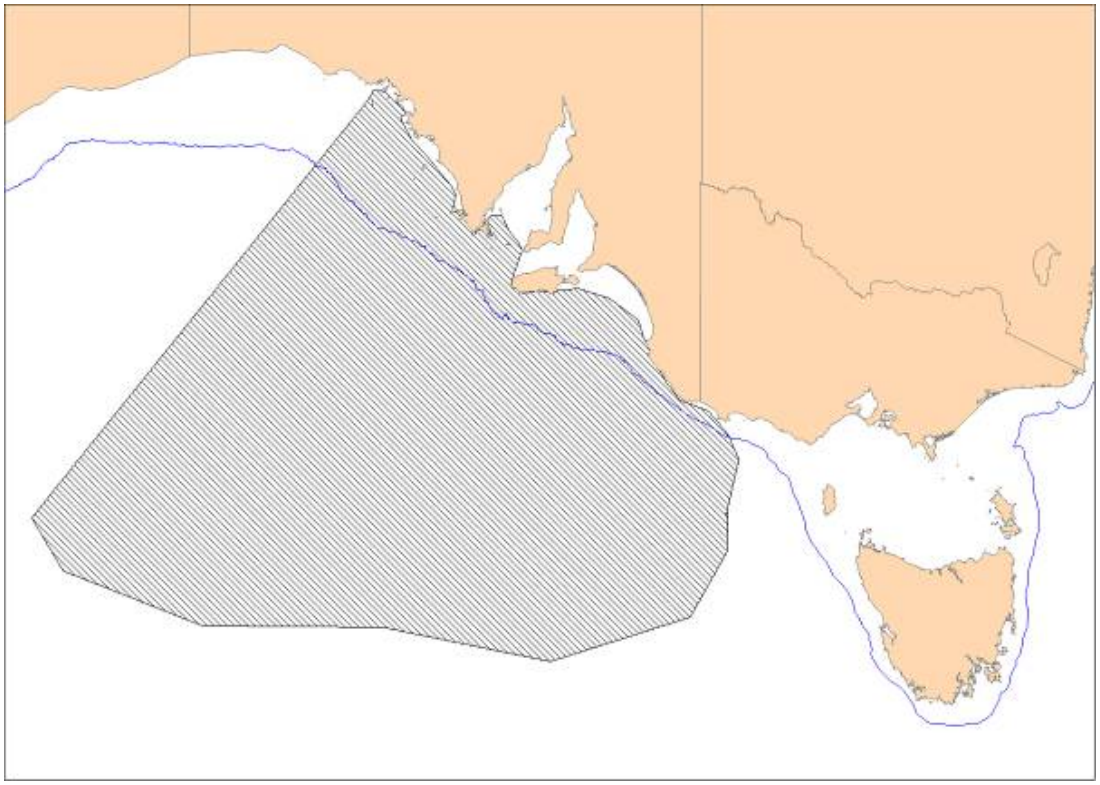

Figure 5. Estimated at-sea distribution of adult female NZ fur seals in South Australia.

5.7 At-sea distribution of juvenile New Zealand fur seals

No data were provided by DEWHA on the at-sea distribution of juvenile NZ fur seals in South Australia.

Based on the results of Page et al. (2006), we have estimated the at-sea distribution of juvenile NZ fur seals in South Australia (Figure 5). This map will be provided to DEWHA as MapInfo files, or other formats, on request (this layer will need to be land-clipped).

Habitat category: foraging

Certainty of occurrence: known to occur

Level of use: high

Season of use: year round

Ecological reason for use: Juveniles use the same habitats as adult males and females, but juveniles also use pelagic waters that are associated with the sub-tropical front, between 600-1000 km south of the continental shelf break.

Source description: Kangaroo Island: Page et al. (2006), Donington Reef: Page and Goldsworthy (unpublished data). Other colonies/regions: extrapolated from satellite tracking data from other sites (Goldsworthy et al. 2003).

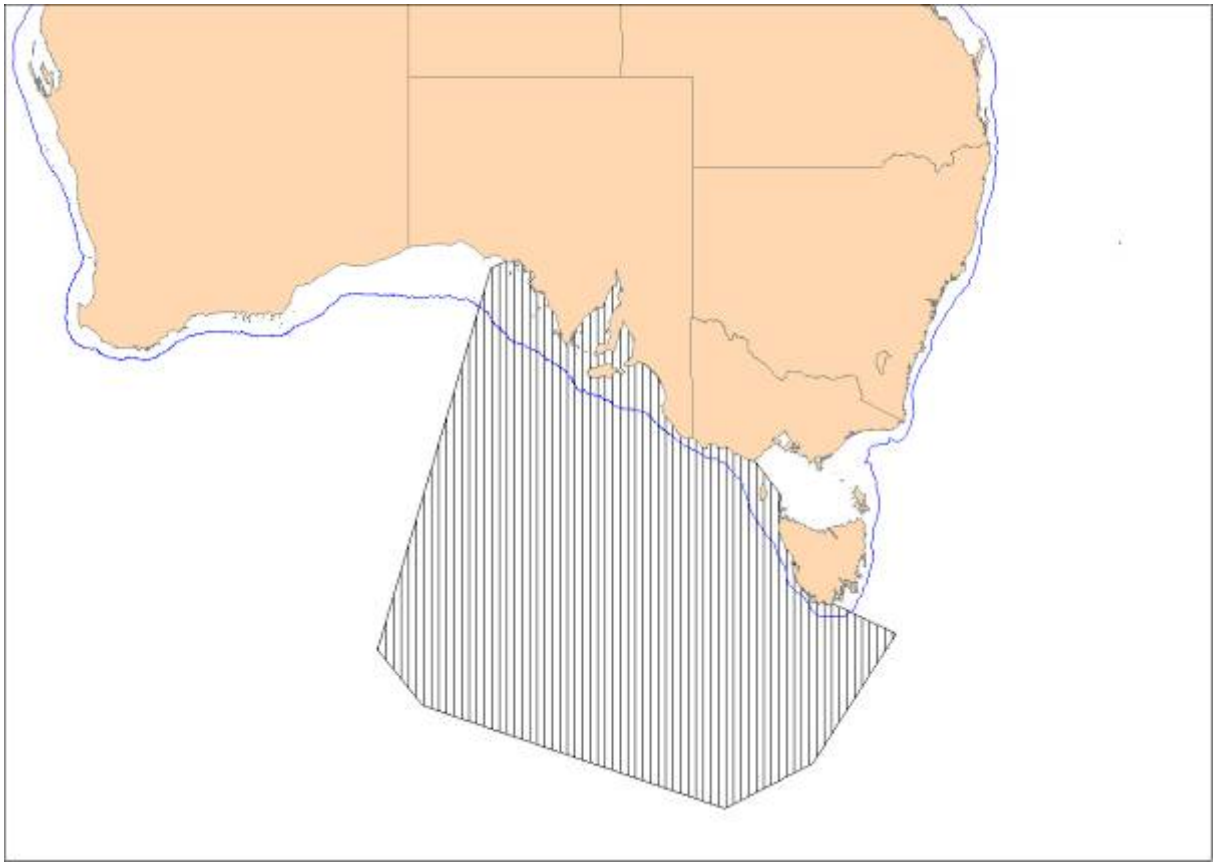

Figure 6. Estimated at-sea distribution of juvenile NZ fur seals in South Australia.

5.8 At-sea distribution of Australian fur seals

No data were provided by DEWHA on the at-sea distribution of Australian fur seals in South Australia.

Based on the results of Arnould and Hindell (2001), Kirkwood et al. (2002), Arnould and Kirkwood (2008), Kirkwood et al. (2006) and Kirkwood et al. (unpublished data), we have estimated the at-sea distribution of Australian fur seals in South Australia (Figure 5). This map will be provided to DEWHA as MapInfo files, or other formats, on request (this layer will need to be land-clipped).

Habitat category: foraging

Certainty of occurrence: known to occur

Level of use: high

Season of use: year round

Ecological reason for use: Australian fur seals (adult females, adult males and juveniles) use the continental shelf. Australian fur seals do not appear to use regions deeper than 200 m.

Source description: Extrapolated from satellite tracking data from other sites (Arnould and Hindell 2001, Kirkwood et al. 2002, Kirkwood et al. 2006, Arnould and Kirkwood 2008, and Kirkwood et al. unpublished data).

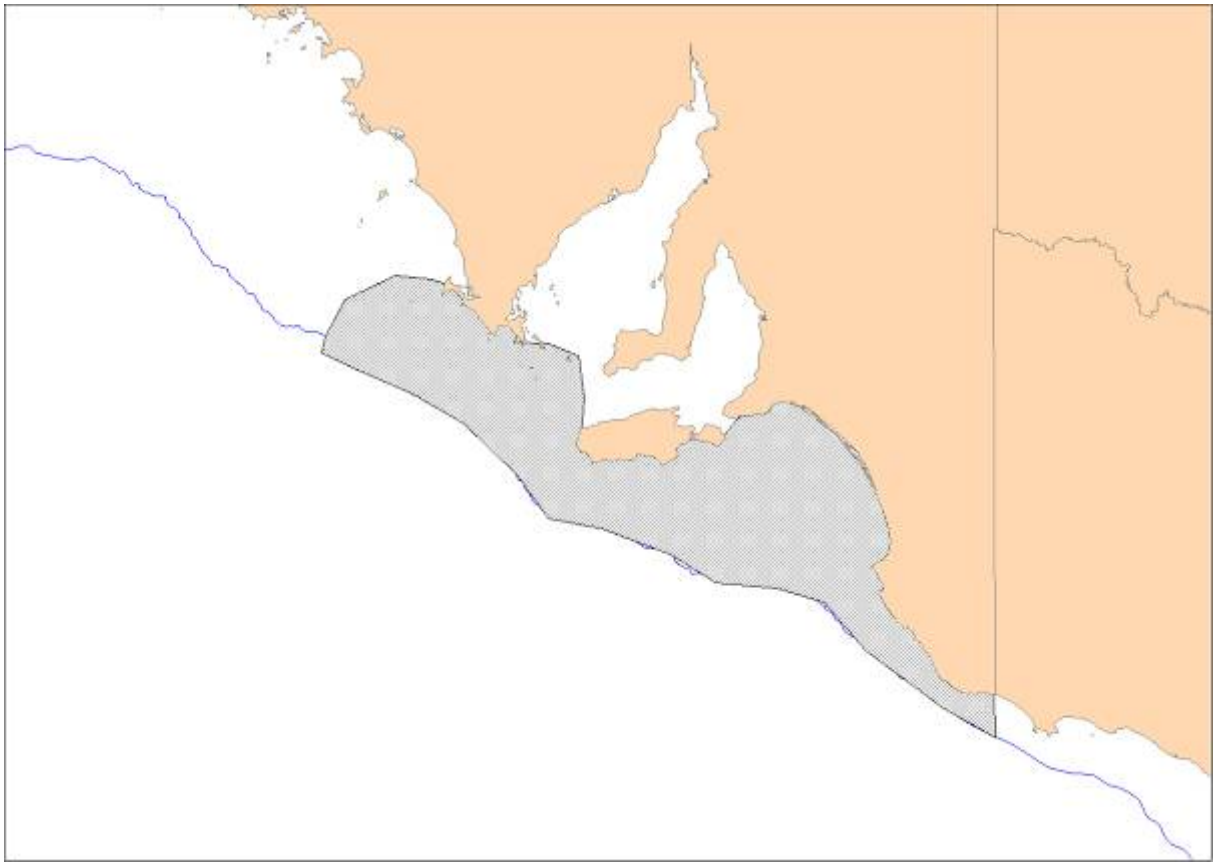

Figure 7. Estimated at-sea distribution of Australian fur seals in South Australia.

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