Lineage – Scientific methodology

Annual Distribution of New Zealand fur seal breeding colonies

[Updated October 2012]

1. A "breeding colony" for New Zealand fur seals (*Arctocephalus forsteri* Lesson, 1828) is defined as "any breeding location where at least 10 pups are born in at least three successive years and where offspring return each year to the same site". NOTE: in some locations established colonies are known, but actual counts or estimates may not have been conducted for three successive years, mainly because of accessibility problems. Further, detailed mark-recapture studies are necessary to determine the return of pups and these occur at very few sites. Comments relating to these points are detailed in the paragraphs below. There is one exception to the definition of a breeding colony that is included as a "known breeding" colony: the small colony at Honeycomb Rock (see below). This colony is constrained by the availability of suitable habitat and 10 or fewer pups are seen there in a season.

2. "Occasional breeding" refers to the boundary of any known location where New Zealand fur seals breed, (though not at a colony level (as defined above)), but not necessarily at that location every year. This category includes locations where occasional births have been recorded. Some locations listed as "occasional" are known amongst the marine mammal community of researchers as rookeries or breeding colonies, though they do not fit the definition given here. This is because the available area restricts the numbers that could possible breed in some locations, e.g. Lynch's Reef or Barney's Rock. These locations operate as breeding colonies, not as haul-outs. Further, the "pups returning" caveat required in the definition above requires long-term tagging data with frequent monitoring. This is not possible for many sites and is assumed to be valid for those localities described here as "known breeding colonies".

3. The use of pup production numbers is the internationally accepted way of determining population sizes and trends (see Taylor et al. 1995), because the pups remain ashore at the colony until they are weaned – at about 8–10 months of age (August–October) (Crawley & Wilson 1976). Most counts are made during December–February when the pups are young. The pup estimates are based on counts of live and dead pups, but single counts are usually of live pups only. For many of the locations given below there have been no systematic surveys and data represent counts made when the opportunity arose and many are "guesstimates". Some estimates given here are based on a season's data, but they at least provide some idea of the possible magnitude of the pupping within a colony. Published estimates are given with either standard error or 95% confidence intervals. Five year mean point estimates are given for the main South Island west coast rookeries (Wekeura Point, Cape Foulwind, and Open Bay Islands). All other numbers are from pup counts or guesstimates, as described below.

NORTH ISLAND & OFFSHORE ISLANDS

a. The northernmost locality where New Zealand fur seal pupping occurs is Gannet Island off the Waikato coast. An aerial photographic survey on 22 January 2007 indicated at least 4 pups on the rock platform on the southern part of Gannet Island (Bouma et al. 2008). Three pups were counted from a similar survey on 26 January 2010 (Anon. 2010). The available area for breeding is small, and this island is considered an occasional breeding colony until evidence shows that pups are regularly born here.
b. Occasional breeding also occurs at Albatross Point where at least one pup was counted on 26 January 2010 and several during the January 2007 survey (Anon. 2010).
c. Between December 1989 and December 2001, less than 10 pups were produced annually at Sugar Loaf Islands (Ngā Motu) Marine Protected Area (Miller & Williams 2003). Numbers have increased, though the colony size is limited by the available habitat. The number given here represents the number of pups (about 12) seen in the 2006–07 season (December–January) at Lion Rock (Whareumu) which is the main pupping area (B. Williams, Department of Conservation, pers comm.). Females and pups then disperse to Moturoa Island, Saddleback Island (Motumahanga), and Seal Rock (Waikaranga) (B. Williams, Department of Conservation, pers comm.). There have been no formal surveys since that season, but 8–12 pups are probably born there each year.
d. Pupping occurs regularly at Honeycomb Rock (H. Best, Department of Conservation, pers. comm.), and the available habitat area restricts colony growth. Up to 10 pups are produced here each season.
e. Between 20 and 50 pups were reported from direct counts made on the rock stack off Cape Palliser as well as on the mainland in February 1999 (H. Best, Department of Conservation, pers. comm.). Counts made in February and March 2010 suggest that annual numbers of pups may now exceed 100 pups (L. Boren, Department of Conservation, pers comm.).

SOUTH ISLAND & OFFSHORE ISLANDS
Nelson-Marlborough to Kaikoura

f. The number for Stephens Island is an approximate estimate of mean annual pup production from the Department of Conservation Nelson-Marlborough Conservancy Office. Published records, with summer survey counts based on binocular counts from vantage points or from a boat close inshore (multiplied by 2.4 after subsampling by foot to ascertain the level of "missed" pups), are given in Taylor et al (1995). Breeding grounds are at the eastern end of Razorback Point and the midsection of the southern shore. Mean annual estimates of pup production given in Taylor et al. (1995) are 264 pups (1991–92), 314 (1992–93), and 276 (1993–94). These represent a large increase on the 1970–71 annual estimate of 4 pups.
g. The published estimated annual pup production for Archway Islands from Taylor et al. (1995) was 6 pups. The rookery is at the southeastern end of the inner island and counts were made using binoculars from a vantage point. Pup production was assessed at three pups in the previous season. These data have been updated by Department of Conservation field staff (Andrew Baxter, Nelson-Marlborough Conservancy Office), and the area has been extended north as far as Cape Farewell because animals are thought to use a wider area for breeding in recent years. The number given is a coarse estimate; many rookeries are not surveyed on a regular basis. However, Department of Conservation field staff recognise this area as a breeding colony and provided a "guesstimate" for 2010 of about 150 pups.

h. The number given for Pillar Point represents the annual pup production for the 1993–94 breeding season; the previous season was assessed at 70 pups (Taylor et al. 1995). Direct counts were easily made from vantage points. No signs of breeding were present in 1984. [Note that Pillar Point is the most northern rocky headland in the broad area described above (Archway Islands to Cape Farewell).]
i. Tonga Island annual pup estimates increased from 92 in 1992–93 to 130 in 1993–94 (Taylor et al. 1995). Boat and walk-through counts and mark-recapture counts were used in the 1993 season, and mark-recapture counts were used in February 1994. In subsequent seasons, mark-recapture estimates reached a maximum of about 179 fur seals in 1998. A 2001 survey estimated 86.4 fur seal pups, s.e. = 7.5 (Boren 2001). A more recent (unpublished) estimate was made in 2011: 173 ± 6 pups (L. Boren, Department of Conservation, pers. comm.).
j. In 2010, Department of Conservation staff provided a "guesstimate" for the recently established breeding colony on Adele Island in the Abel Tasman National Park – about 30 pups.
k. A breeding colony has recently been established at Trio Islands (Kuru Pongi), and the count given is for January 2007 (about 50 pups that were counted from a boat as part of a wider survey of Marlborough Sounds).
l. Pupping occurs in small numbers at Pinnacle Island, where the physical area limits the carrying capacity and about 10 pups is probably the maximum number in a season.
m. The pup numbers for the breeding colony at Separation Point are rough estimates provided by Department of Conservation field staff in 2010.
n. Data for Barney's Rock (10 km south of Kaikoura Peninsula and also known as Riley's Lookout and Panau Island) include an area on the mainland near Rosy Morn Stream and directly opposite Barney's Rock.
o. Fur seals are extending their breeding location around the Kaikoura Peninsula and in 2009, direct counts made by Department of Conservation staff suggest that about 100 pups were born in 2009 in the reef area from Point Kean or Lynch's Reef south to Sugar Loaf Point.
p. Data for Ohau Point (12 km south of Clarence River) are based on mark-recapture work (Petersen estimates) and indicate the population is expanding (Boren 2005). The population expanded by 32% per annum over the years 1990–2005 (Boren et al. 2006) and at a rate of 25% from 2005–09 (L. Boren, Department of Conservation, unpublished data). An estimate of 600 pups was reported for 2005 (Boren 2005). The estimate for the 2008–09 season was more than double this, at 1508 (s.e. = 28) pups (L. Boren, Department of Conservation, unpublished data). The 2011 estimate provided by L. Boren is 2390 (s.e. = 226) pups.
q. The number given for Kahurangi Point is a "guesstimate" made in 2007 by Department of Conservation field staff. The population is increasing, but no formal counts have been made.

Canterbury (including Banks Peninsula) to Otago

r. Fur seals are known to breed along the North Canterbury coast from Motunau Beach to Waiau River where there is suitable habitat, but as of October 2010 there have been no surveys of pup numbers (Laura Allum, Department of Conservation pers. comm.).
s. Mark-recapture techniques during February 2002, 2003, and 2005 were used to estimate pup production at Horseshoe Bay on Banks Peninsula (Boren 2005). This population may have reached its carrying capacity. Two smaller colonies have been established at Island Bay and Whakamoa Bay and it is suggested that these may include animals from Horseshoe Bay (Boren 2005, Boren et al. 2006).
t. Mark-recapture techniques during January-February 2003–05 were used to estimate pup production at Te Oka Bay on Banks Peninsula (Boren 2005, Boren et

al. 2006). Since 2002 pup production has increased from <100 to almost 300 pups per annum.

u. Ryan et al. (1997) noted that breeding occurred at headland areas of Banks Peninsula where previous haulouts were recorded: Flea Bay, Pompey's Pillar, Goat Point South, and Ducksfoot Bay. Many other sites on Banks Peninsula are now known to have colonies: Long Lookout Point, Murray's Mistake, Boaz, Robin Hood Bay, Hell's Gate, Peraki Bay, Long Bay–Island Bay, Rocky Nook, Waihuakina Bay, Damons Bay eastern head, Redcliffe Point, Short Reef point, Otanerito Bay, Goat Point, South Head, North Head, Hickory Bay, Putakolo Head, Steep Head–East Head (L. Allum, Canterbury conservancy, Department of Conservation). The pup numbers given are "guesstimates" based on work completed in 2007, with some updates from 2011, including some new colony areas at Scenery Nook, Damons Bay, western heads Akaroa Harbour, West Head, coastline near Pa Island, Katawa Head, Stony Bay, and Shell Bay-Red Bluff (D. Cox, Akaroa Field Base, Department of Conservation). Some of the colonies along the Banks Peninsula coastline were affected by rockfalls from the series of nearby Canterbury earthquakes since September 2010 (D. Cox, Department of Conservation).
v. The record for Oamaru Harbour is from 1992–93 (Lalas & Harcourt 1995).
w. Data given for the following locations (with the most recent surveyed year) are counts of live pups from surveys undertaken by Chris Lalas at Otago colonies: Moeraki Peninsula (2008–09), Shag Point (2008–09), Heyward Point (2009–10), Green Island Nature Reserve (2009–10), and Sandy Bay to Tucks Cove (2008–09). The live pup counts for the whole of the Otago Peninsula in 2008–09 are given for: Otago Peninsula – north (Taiaroa Head to north end of Victory beach); Otago Peninsula – centre (south end of Victory Beach to north end of Allen's Beach); and Otago Peninsula – south (south end of Allen's Beach to Seal Point (Chris Lalas, pers. comm.). Data for Penguin Bay are from a January-March survey in 2003 (Chris Lalas, pers. comm.).

West coast to Southland and Stewart Island

x. Data for Wekakura Point, Cape Foulwind, Black Reef, Charleston, and Open Bay Islands represent the mean annual estimated number of pups for the 2006–2010 seasons (Department of Conservation West Coast Tai Poutini Conservancy & Hugh Best, unpublished data). None of these estimates take into account pup mortality between birth and the time when the counts were made. The Open Bay Islands data are based on mark-recapture data from the main rookery at Taumaka Island. [A smaller colony exists on nearby Popotai Island but these numbers are not included in the Taumaka Island estimate.] Mark-recapture methods were also used to derive the mean estimates for Wekakura Point and Cape Foulwind. For the 2006–08 seasons at Wekakura Point, the annual pup estimates were between about 450 and 550 pups (and these estimates are within the range of annual estimates since 1999). However, the estimate for 2009 was 305 pups and this represented the lowest annual count in the 1992–2009 series. For Cape Foulwind, the annual pup estimates for the 2006–08 seasons were similar to those for the previous five years, between about 250 and 310 pups. The 2009 estimate was slightly lower at 203 pups. For Taumaka Island, annual pup estimates for 2006–08 increased each year, from about 1000 to 1300 pups. The 2009 estimate was 941 pups. For all these colonies, pup numbers estimated in the 2000s were generally lower than those estimated for the 1990s. An aerial photographic survey of these three colonies in 2009 was unable to provide similar counts to mark-recapture estimates produced from ground counts provided above (Baker et al. 2010).
The most recent pup estimates (2011) for Wekekura Point, Cape Foulwind, and Taumaka Island provided by the West Coast Conservancy of the Department of

Conservation are very similar to those for 2009 (Department of Conservation West Coast Tai Poutini Conservancy & Hugh Best, unpublished data).

y. For Charleston, a mark-recapture estimate (mean of five estimates) the Cape Foulwind data series was used with an appropriate conversion factor to derive a mean estimate (H. Best pers comm.). For Black Reef, the same conversion factor was applied to pup count data from a boat survey in January 1989 by Anderson (1990) (H. Best pers comm.).

z. Data for Otukoroiti Point, Kongahu Point, Cascade Point, Hanata Island, and Point Elizabeth are field counts from Department of Conservation West Coast Conservancy staff (as supplied by Deborah Watson, University of Otago student).

aa. Data for Yates Point south to Chalky Island are from the Department of Conservation Southland Conservancy Excel spreadsheet that summarises all Department of Conservation fur seal counts and a map of known breeding colonies and haulouts in the Fiordland area (provided in 2002). These data vary in the type of data collected and time of year of the visit. Data represent direct counts from boats or land visits. Although there are not pup production numbers available for consecutive years for these rookeries, Department of Conservation field staff confirm that breeding colonies exist at the nominated locations. Pup production numbers are given where data exist. The Yates Point count was made in September 1986. Note that this count was made outside the breeding season of November to March.

bb. Pup numbers are unknown for Shelter Island (Doubtful Sound).

cc. Data from one bay and one peninsula on Breaksea Island are summarised from direct counts made by boat and by foot at two sites (about 140 pups at North West Bay and about 8 at North East Peninsula) in February 1992.

dd. A survey undertaken in mid January 2009 provided land-based counts from two colonies. At Wairaki Island just south of Breaksea Island, direct counts by three observers were made during a walk-through of the colony and a mark-recapture estimate was derived for a colony at one of the Seal Islands in Dusky Sound, based on counts by four observers (E. Mellina & M. Cawthorn, unpublished data).

ee. Fur seals breed on the western coastline of Five Fingers Peninsula and at Seal Islands (Rocks) at the entrance of Dusky Sound (Hugh Best, Department of Conservation, pers. comm.).

ff. Counts were made in July 1983 from Newton River-Cape Providence and 13 immature fur seals and 1 juvenile was found. Note that this count was made outside the breeding season of November to March.

gg. Data for Chalky Island date from 1947, when about 1000 seals were counted in December. Data from 1972 suggest breeding colony several sites, with a minimum of 1000 fur seals.

hh. Unknown numbers of pups are born at rocky beaches off Southland including at The Rocks near Riverton and Pahia Point (R. Cole, Department of Conservation).

ii. Data for many of the islands around Stewart Island are based on work collated by Deborah Watson of Otago University in the early 2000s. Historical information is available in Wilson (1981). James Holborow of Otago University also provided comments on the presence or absence of pups around Stewart Island and offshore islands. Few comprehensive surveys have been carried out other than at Codfish Island and Bench Island. The pup numbers given for Edwards Island are from a single land-based count of over 300 pups in the mid-late 2000s, and the pup number for Kundy Island is a “guesstimate” made in 2012 (P. McClelland, Department of Conservation). Numbers are unavailable or unknown for Jacky Lee (Pukeokaoka) Herekopare, Ruapuke, Tia, Breaksea, Owen (Horomamae), Ernest, Little Moggy, Big Moggy, Solomon, Tamaitemioka, Pohowaitai, Big South Cape, and Murphy islands. The same comment applies to Bunker Islets and South Islets.

jj. The pup number given for Bench Island is the mark-recapture estimate and confidence intervals for a survey completed in 2009 (G. Funnell, Department of Conservation).

kk. The count for Northwest Bay on Codfish Island (Whenuahau) was made in January 1997 and provided by James Holborow of Otago University.

ll. The estimate range for Big Bight Bay on Codfish Island is based on mark-recapture work done by Corey Bradshaw during the 1996–98 breeding seasons and was provided by James Holborow of Otago University.

mm. South of Big Bight Bay on Codfish Island, pups were observed during the 1996–98 breeding seasons (James Holborow, Otago University, pers. comm.).

nn. Some pups were observed at South Bay on Codfish Island during the 1996–98 breeding seasons.

CHATHAM ISLANDS & SUB-ANTARCTIC ISLANDS

oo. The numbers for Bounty Islands are from Taylor (1996) and are based on large-scale oblique aerial photographs taken in January 1994. This gave a rough estimate of the annual pup production at 4 380 pups based on a 37:63 ratio of pups to other seals of one year or more in age and includes an additional 20% pups missed or already dead. This value was based on a sample of only 10% of all seals and is an increase from the 3 280 pup count made in 1980–81 (Taylor 1982). Taylor (1996) gives a total estimate of 1 225 pups for the 1993–94 breeding season at Penguin Island, an increase from 863 in 1980–81. The main known breeding colonies are at Spider Island, Depot Island, Penguin Island, Ruatara Island, and Funnel Island. Haulouts are present on most islands and rocks. Penguin Island and Depot Island are thought to have reached carrying capacity. The area used for haulouts and breeding increased by about 30% between 1980 and 1985. The islands are monitored infrequently due to their inaccessibility and no recent updates are available.

pp. The pup number for the Snares Islands is from a count from North East and Broughton Islands in March 1997 and includes all pups seen; an earlier census of fur seals throughout the islands and islets of the Snares Islands group was conducted in February 1984 and resulted in a pup count of 164 pups (Carey 1998). Counts were made by use of binoculars from high vantage points. Sixteen breeding sites are listed in Carey (1998), seven of which meet the numerical criterion of the breeding colony definition. Aerial photographs showed that fur seals were present in all areas of suitable habitat and that the breeding areas were physically defined from the haulout areas. Fur seals were present around most of the coastlines of the islands, with the main breeding areas on the southern and western coasts of North East Island and the haulout area on the eastern coast. Carey (1998) notes three new breeding areas have been established on the east coast since a census in 1970–71 (reported in Crawley 1972). No recent updates are available.

qq. Data for the Solander Islands group are from Wilson (1981) and include all data where the pup counts are separately defined from the overall fur seal count. Thus, the data probably represent the minimum total pup presence. Counts were made from the beach for Solander Island bays and rock stacks during January 1973. No recent updates are available.

rr. Reef Point on Antipodes Island is the only location for which there is a published direct count of fur seal pups, from March 1985 (Taylor 1992). No breeding was seen in earlier trips in February-March 1969 or November-December 1978. No recent updates are available.

ss. Marine mammal work on Campbell Island is concentrated on New Zealand sea lions, thus few data exist on the presence of fur seal breeding colonies. A breeding colony exists at Rocky Beach, with at least 10 pups seen in some seasons, but surveys here are not regular. Fur seal breeding sites on Campbell Island are

restricted by the habitat available and the presence of New Zealand sea lions (P. McCelland, Department of Conservation Southern Islands, pers. comm.). Further information is available in Wilson (1981). No recent updates are available.

tt. Fur seals breed at Derry Castle Reef on Enderby Island, Auckland Islands. No breeding colonies are known to exist on Auckland Island, but colonies were present along the western cliffs of Auckland Island and the southern coast of Adam Island during the 1800s.

uu. There is occasional breeding on the western coast of Disappointment Island, Auckland Islands (P. McCelland, Department of Conservation Southern Islands, pers. comm.).

vv. There are no recent data available for the fur seal populations on islands in the Chatham Islands group. Wilson (1981) names some rookeries, and the existence of these breeding colonies given for these islands, as well as for The Pyramid, has been confirmed by Department of Conservation staff based at the Chatham Islands area office: South East Island, Eastern Reefs, Western Reef, Point Munning, and Star Keys, The Pyramid.

ww. Occasional pupping occurs at Macquarie Island (Goldsworthy et al. 1998), though this is likely to be a rare event. Intraspecific breeding between *Arctocephalus gazella* (Antarctic fur seal) and *A. tropicalis* (subantarctic fur seals) and very occasionally *A. forsteri* occurs here at Secluded and Goat Bays on North Head Peninsula at the northern tip.

4. Literature sources were searched for information on the distribution of breeding colonies or occasional breeding locations.
   a. Aquatic Sciences and Fisheries Abstracts (1960–2012)
   b. Fish and Fisheries Worldwide (1971–2012)
   c. BIOSIS Previews (1993–2012)
   d. NZ Science (1800–2012)
   e. Department of Conservation library databases
   f. Scientific papers, unpublished reports, and university theses.

5. Other sources.

   a. Data and associated information in the form of maps, spreadsheets, and verbal and email comments were provided by marine mammal staff and students of Otago University, researchers Chris Lalas who does unpaid monitoring of pups at Otago with logistics funded by Sanford Ltd and Hugh Best, and staff at the Department of Conservation Conservancy Offices. The main Conservancy contacts for the 2010 update are given in parentheses: East Coast-Hawkes Bay (Andy Bassett); Waikato (Kristina Hillock); Wanganui (Jim Campbell, Callum Lilley); Wellington (Laura Boren); Chatham Islands (Jim Clarkson), Nelson-Marlborough (Andrew Baxter); Canterbury (Laura Allum); Otago (Jim Fyfe), Southland, including Southern Islands (Greig Funnell, Peter McClelland), and West Coast (Don Neale). The owners of Taumaka me Popotai (Open Bay Islands) are acknowledged for their agreement to allow access to Taumaka as part of the pup census work.

6. All colonies are mapped according to written/oral descriptions of their locations which are defined either by gazetted or colloquial names and may not have well defined area boundaries. Department of Conservation staff, University of Otago staff and students, and independent researchers conducted surveys to produce the counts. Many counts have been made on an *ad hoc* basis, rather than being formal censuses. For the categories that describe where breeding colonies could exist but are unmapped or for areas where breeding colonies are known not to exist, marine mammal researchers note that the availability of suitable habitat will define many of these areas (for example, see

Ryan
et al. 1997, Bradshaw et al. 1999).

7. Summary
   a. Information from the electronic databases, literature sources, and expert discussion were integrated to produce hand-drawn distributional zones on a template map. These maps were then digitised and imported into GIS software as layers. The areas of the zones were calculated, and the layers were linked to attribute and metadata files.
   b. The primary data for breeding colonies were from Department of Conservation spreadsheets, Otago University spreadsheets, and published literature.
   c. The historical distribution of New Zealand fur seal breeding colonies was more extensive than the present day distribution (Mattlin 1987, Taylor 1992, Lalas & Harcourt 1995, Lalas & Bradshaw 2001). Harvesting by sealers heavily reduced populations until 1894 when the Government closed the fur seal fishery, though Campbell Island fur seals continued to be harvested under special permits until 1946. The Marine Mammal Protection Act (1978) gives total protection to fur seals, though fur seals are caught in commercial fishing operations, particularly during trawl fishing (Baird 2004). Populations are now increasing in many areas of their current range: around New Zealand, southern and western Australia, and sub-Antarctic islands (Crawley 1990, Shaughnessy et al. 1994, Lalas & Bradshaw 2001). In the past decade unpublished estimates of pup numbers calculated from mark-recapture data for Cape Foulwind and Wekekura Point on the South Island west coast indicate a decreasing trend in pup numbers over the last 10 years (Department of Conservation West Coast Tai Poutini Conservancy & Hugh Best, unpublished data). A national census has been considered, but not actioned. Wilson (1981) provides the most recent synthesis of fur seal counts and estimates. Otherwise, numbers exist in various spreadsheets held chiefly by the Department of Conservation and Otago University. It is not obvious from some of these spreadsheets how the counts were made and what proportion of the numbers were pups. Further, many breeding locations are not visited frequently enough (often due to their geographic isolation) to fit the definition given above for a “breeding location”, and researchers may use different criteria to determine what constitutes a “breeding location” or rookery.

8. References

The following sources provided useful information on New Zealand fur seals and the location of breeding colonies and occasional breeding sites. This is not an exhaustive list of all references to New Zealand fur seals and may include references that provide background information on pup production.

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