Appendix 1: Worldwide territories and regions of leopard seal occurrence.

Geographical territories and regions where leopard seals have been recorded and their occurrence patterns in these areas is shown in Table 1.1 The term 'seasonal' is used within the framework of presence for some months of the year only, i.e., they have not been recorded year-round. The term 'year-round' is used within the framework of their presence for all months of the year but may only refer to some areas within the region. If conflicting information existed regarding 'seasonal' versus 'year-round' occurrence in region, then both occurrence types were listed. Note that only one reference is cited for either seasonal or year-round, although we recognise that there are multiple publications to support occurrence patterns for some locations.

Table 1.1: Geographical territories and regions where leopard seals have been recorded and their occurrence patterns in these areas.

Territory	Region	Occurrence
Antarctica	Mainland	Year-round (Rice 1998)
	Balleny Islands	Seasonal (Wilson 1966)
	Paulet Island	Seasonal (Anderson 1908)
	South Orkney Islands	Year-round (Rice 1998) Seasonal (Hamilton 1939)
	South Shetland Islands	Year-round (Rice 1998) Seasonal (Hamilton 1939)
Australia	Mainland	Seasonal (King 1983)
	Heard & McDonald Islands	Year-round (Brown 1957)
	Heron Island	Seasonal (King 1983)
	King Island	Seasonal (Troughton 1951)
	Lord Howe Island	Seasonal (King 1983)
	Macquarie Island	Year-round (Rice 1998) Seasonal (Rounsevell and Eberhard 1980)
	Stradbroke Island	Seasonal (Haynes-Lovell 1994)
	Tasmania	Seasonal (King 1983)
Cook Islands	Cook Islands	Seasonal (King 1983)
France	Amsterdam Island	Seasonal (Rice 1998)
	Crozet Islands	Seasonal (Rice 1998)
	French Polynesia	Seasonal (Reeves et al. 1992)
	Kerguelen Islands	Year-round (Bester and Roux 1986)
	Saint-Paul Islands	Seasonal (Rice 1998)
New Zealand	Mainland	Seasonal (Falla 1965) Year-round (King 1983)
Norway	Bouvet Island	Year-round (Rice 1998)
Solomon Islands	New Georgia	Seasonal (Wilson 1907)
South Africa	Prince Edward Island	Seasonal (Rice 1998)
	South Africa	Seasonal (Reeves et al. 1992)
South America	South America	Year-round (Aguayo-Lobo et al. 2011) Seasonally (Reeves et al. 1992)
United Kingdom	Falkland Islands	Seasonal (Hamilton 1939)
	Pitcairn Islands	Seasonal (Stewart and Grove 2014)
	South Georgia Islands	Year-round (Rice 1998) Seasonal (Walker et al. 1998)
	South Sandwich Islands	Seasonal (Hamilton 1939)
	Tristan da Cunha	Seasonal (Rice 1998)

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Appendix 2: Published records of leopard seal specimens (deceased animals) and sightings in New Zealand.

Published records of leopard seal specimens (deceased animals) and sightings (live animals) in New Zealand waters (including New Zealand Subantarctic islands) are listed in Table 2.1. The date of each record is entered using the format yyyymmdd (where year, month and day were known, otherwise year, or year + month are indicated). If records were confirmed as the same event (i.e., the same record was cited by subsequent authors) the data were entered herein as one record, with all citations listed (e.g., see the third entry, where two authors, Butts (1977) and Smith (1985) both describe the same leopard seal sighting.

Table 2.1: Published records of leopard seal specimens and sightings in New Zealand waters (including New Zealand Subantarctic islands).

Date first sighted	Type of record	Region	Reference(s)
1200	Specimen	Papatowai Point, Otago[a]	Smith 1985
1400	Specimen	Moa Bone Point Cave, Redcliffs, Christchurch, Canterbury	Smith 1985
1400	Specimen	Rotokura, Cable Bay, Nelson, Nelson/Marlborough	Butts 1977; Smith 1985
1700	Specimen	Long Beach, Dunedin[b]	Smith 1985
184311	Specimen	Evans Bay, Port Nicholson (Wellington Harbour), Wellington[c]	Richardson 1844; Sherrin 1886
1866	Sighting	Auckland Islands	Musgrave 1866
1866	Specimen	Nine-mile Bluff	New Zealand Geological Survey Staff and Fleming 1968
1885	Specimen	Porangahau, East Coast/Hawkes Bay	Hamilton 1885
1907	Specimen	Venus Cove, Campbell Island	Waite 1909
1912-1921	Specimen	Tipi Bay, Marlborough Sounds, Nelson/Marlborough	Grady 1982
19420826	Sighting	Perseverance Harbour, Campbell Island	Bailey and Sorensen 1962
19430823	Sighting	Campbell Island	Bailey and Sorensen 1962
19430906	Sighting	Campbell Island	Bailey and Sorensen 1962
19451103	Sighting	Shag Rock, Hauraki Gulf, Auckland	Guy 1947
19570816	Sighting	Tucker Cove, Campbell Island	Bailey and Sorensen 1962
19570912	Sighting	Tucker Cove, Campbell Island	Bailey and Sorensen 1962
19580213	Sighting	Southern coast of Campbell Island	Bailey and Sorensen 1962
19580914	Sighting	Perseverance Harbour, Campbell Island	Bailey and Sorensen 1962
19590726	Sighting	Garden Cove, Campbell Island	Bailey and Sorensen 1962
19590901	Sighting	Tucker Cove, Campbell Island	Bailey and Sorensen 1962
19591011	Sighting	Tucker Cove, Campbell Island	Bailey and Sorensen 1962
19591015	Sighting	Old homestead, Campbell Island	Bailey and Sorensen 1962
19600811	Sighting	Tucker Cove, Campbell Island	Bailey and Sorensen 1962
1964	Sighting	Wellington	Gaskin 1972
1966	Sighting	Manawatu River	Gaskin 1972
1967	Sighting	Marineland, New Zealand	Gaskin 1972
197206	Sighting	North Arm Beach, Snares Islands	Horning and Fenwick 1978

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Date first sighted	Type of record	Region	Reference(s)
197208	Sighting	Hawke's Bay, East Coast/Hawkes Bay[d]	Davis et al. 1977
197208	Sighting	Station Cove, Snares Islands	Horning and Fenwick 1978
1976	Sighting	Campbell and Auckland Islands	Rounsevell 1988[2]
19761123	Sighting	Seal Cove, Main island, Snares Islands	Horning and Fenwick 1978
1977	Sighting	Campbell and Auckland Islands	Rounsevell 1988[2]
19770112	Sighting	Boat Harbour, Snares Islands	Horning and Fenwick 1978
1978	Sighting	Campbell and Auckland Islands	Rounsevell 1988[2]
1980	Sighting	Campbell and Auckland Islands	Rounsevell 1988[2]
1981	Sighting	Campbell and Auckland Islands	Rounsevell 1988[2]
1982	Sighting	Campbell and Auckland Islands	Rounsevell 1988[2]
1983	Sighting	Campbell and Auckland Islands	Rounsevell 1988[2]
1984	Sighting	Campbell and Auckland Islands	Rounsevell 1988[2]
1985	Sighting	Campbell and Auckland Islands	Rounsevell 1988[2]
19900612	Sighting	Hitaua Bay, Marlborough Sounds, Nelson/Marlborough	Duffy and Brown 1994
19900625	Sighting	Crail Bay, Pelorus Sound, Nelson/Marlborough	Duffy and Brown 1994
1991	Sighting	Marineland, New Zealand	Rogers et al. 1996
19960819	Bycatch	South Pacific Ocean	Berkenbusch et al. 2013; Abraham et al. 2017
19971001	Bycatch	South Pacific Ocean	Berkenbusch et al. 2013; Abraham et al. 2017
200209	Sighting	Waitangi, Chatham Islands	Miskelly 2008
20050918	Bycatch	South Pacific Ocean	Rowe 2009; Abraham and Thompson 2011; Berkenbusch et al. 2013; Abraham et al. 2017
20070703	Sighting	Otago Harbour, Otago	McKinlay et al. 2014
20121007	Sighting	Taiaroa Head, Otago	McKinlay et al. 2014
Unknown	Specimen	New Zealand	Sherrin 1886
Unknown	Specimen	Island Bay, Wellington	Hector 1897
Unknown	Sighting	Port Nicholson (Wellington Harbour), Wellington[c]	Wilson 1907; Scheffer 1958
Unknown	Sighting	Waikato River, Waikato	Wilson 1907; Scheffer 1958
Unknown	Sighting	Wanganui River, Wanganui	Wilson 1907; Scheffer 1958
Unknown	Sighting	Subantarctic islands	Falla 1965
Unknown	Sighting	Snares Islands	King 1983
Unknown	Specimen	Wheritoa, Bay of Plenty	Smith 1985
Unknown	Specimen	Lookout Bluff, Otago[e]	Smith 1985
Unknown	Specimen	Omimi, Otago[f]	Smith 1985
Unknown	Specimen	Lookout Bluff, Otago[e]	Hamel 2001
Unknown	Specimen	Omimi, Otago[f]	Hamel 2001
Unknown	Specimen	Long Beach, Dunedin, Otago[b]	Hamel 2001

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Date first sighted	Type of record	Region	Reference(s)
Unknown	Specimen	Papatowai, Otago[a]	Hamel 2001
Unknown	Bycatch	Unknown	Duignan 2003
Unknown	Sighting	Hawke's Bay[d]	van den Hoff et al. 2005
Unknown	Sighting	Westport, West Coast	van den Hoff et al. 2005
Unknown	Sighting	Gisborne, East Coast/Hawkes Bay	van den Hoff et al. 2005
Unknown	Sighting	New Plymouth, Whanganui	van den Hoff et al. 2005
Unknown	Sighting	Unknown	van den Hoff et al. 2005
Unknown	Sighting	Unknown	van den Hoff et al. 2005

[1] Publication states that record was also collected by A. McKay in 1873.

[2] Rounsevell (1988) included 50 records in 1976, 23 in 1982 and less than 10 per year in 1976, 1978-1981, 1982-1985.

[a-f] Possible duplicate records.

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Appendix 3: Museum records and Archives New Zealand.

Museum Records

Specimens of leopard seals originating in New Zealand and held in Museums were located by searching the published literature and online databases. Additionally, museums were contacted and were requested to supply data accompanying any specimens sourced from New Zealand. The museums contacted included Auckland Museum, Canterbury Museum, Dargaville Kumara Box (private museum), Hawkes Bay Museum, Museum of New Zealand Te Papa Tongarewa, Otago Museum, Southland Museum and Whanganui Regional Museum.

We searched the document archives at Museum of New Zealand Te Papa Tongarewa (formerly Dominion Museum) and examined correspondence, reports and newspaper clippings from 1929 to 1974 held in the MU000002/50 series of files.

We examined archived notebooks, images, reports and correspondence held at the National Library of New Zealand (Alexander Turnbull Library). Robert Falla's and Charles Fleming's archives relating to the Cape expedition (Auckland and Campbell Islands 1941-1945), Auckland Island expeditions (1954, 1962-1963, 1966), and diaries and notes from Campbell Island meteorological staff (1955-1960).

We searched published and online records for New Zealand leopard seal specimens held in museums overseas.

Archives New Zealand

The New Zealand Government online archival system, Archives New Zealand[1], contains historic and contemporary records and links to other online databases. Using this we compiled online records and located the whereabouts of hard copies.

We accessed the hardcopy records of Archives New Zealand in Christchurch including: Antarctic General; United States Antarctic Research Programme and National Science Foundation (R1127969), projects & programmes: University of Canterbury – seal census (R937292), marine mammals – seal reports (R21905614), projects and programmes – general (R1127968), policy & programme – N.Z. Alpine Club expedition (R1127819), Antarctic programme – not logistics (R1127784), and general – information enquiries (R1127728 and R1127730).

In Wellington, we accessed the hard copy records of Archives New Zealand including: Wildlife in captivity - New Zealand zoos, gardens, etc - Napier Council (R2262793), New Zealand Wildlife Service - Hawke's Bay – wildlife in captivity - Napier City Council (R24816428), Department of lands and survey – coastal marine – Edwin Fox (R1127968), seals-general file (R19978627; R19978630; R19978631), and fish & fisheries / seals-protection of seals & general (R23476419).

[1] https://archives.govt.nz/

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Appendix 4: Measurements of leopard seals (standard/estimated length).

While leopard seals are often measured using a straight-line distance from the tip of the snout to the tip of the tail, this methodology can be difficult to apply if the animal is not physically handled, because leopard seals usually position their tail between their hind flippers, i.e., the tail is not always visible or available as a measurement point. Therefore, for this study leopard seals (alive or dead) were measured using a straight-line distance from the tip of the snout to the tip of the hind flipper (as adapted from Staniland et al. 2018). While we recognise that this methodology may result in overall greater lengths for leopard seals (which may prohibit direct comparison to other studies), it is considered robust for comparisons within the New Zealand leopard seal population and other studies where the seals are not handled for measurements.

If the leopard seal was dead, full necropsy measurements were taken (adapted from Pugliares et al. 2007). These measurements were from the tip of snout to the tip of tail and the tip of snout to the tip of the hind flippers.

In order to minimise disturbance to live leopard seals, measurements were taken in two different ways:

1. A rope marked at 50cm intervals was placed alongside the animal (Figure 4.1). To mitigate any disturbance to the seal, the rope was positioned by two researchers who remained at distances of at least 10m from either end of the seal (i.e. at least 10m from both the head and hind flippers).

The rope was then slowly moved to lie approximately 1m from the seal and parallel to its body. A photograph was then taken of the seal next to the rope, noting the two points on the measuring tape which aligned with the tip of the snout and the tip of the tail.

Depending on the seals behaviour, the rope was either promptly removed, or it was left in position and collected after the seal had departed. Once the rope was removed or the seal had departed, the distance between the two points on the rope was recorded.

Figure 4.1: A marked rope (blue line in photo above) is carefully placed approximately 1m away, and parallel to, a leopard seal. Photograph by LeopardSeals.org.

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2. If a rope marker could not be used, a photograph was taken of the seal in alignment with two points which acted as visual markers of the position of the tip of the snout and the tip of the hind flippers (Figure 4.2). Once the seal had departed, the distance between the two points was measured.

A variation of this two-point measurement method, was to draw marks on the ground (e.g., in the sand), or to place two markers on the ground, at 90° to the tip of the snout and the tip of the hind-flippers. In all instances these marks were placed at least 10m away from the leopard seal, therefore although the measurement of the seal was done as a 'proxy' length, this method was estimated to be within 5cm of the actual length of the seal.

Figure 4.2: A leopard seal lying on a pontoon, where two points can be subsequently used to 'proxy' measure the length of the animal after it has departed. The white arrows indicate the red tape placed to mark the previous position of the leopard seal. Photographs by LeopardSeals.org.

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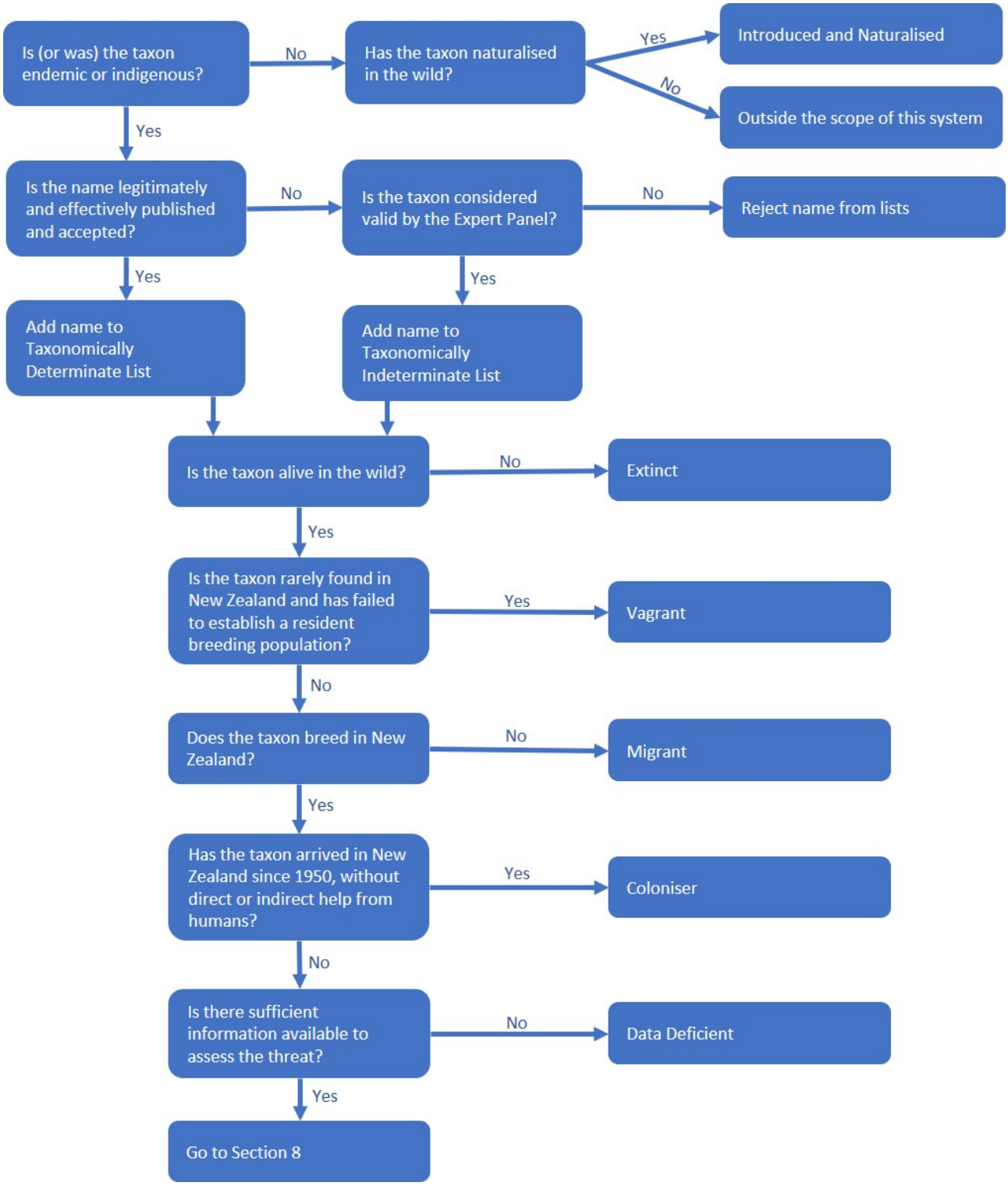
Appendix 5: Assessment of leopard seals threat status against the New Zealand Threat Classification System (NZTCS).

The New Zealand Threat Classification System (the official New Zealand Government system for assigning threat classifications to taxa; NZTCS; Townsend et al. 2008) includes a flowchart to classify New Zealand taxa as; 'Extinct', 'Non-Resident' (including 'Vagrant', 'Migrant' and 'Coloniser' categories) or 'Data Deficient' (Figure 5.1). When taxa do not meet the criteria for any of these categories they are classified as 'Resident'.

Figure 5.1: The New Zealand Threat Classification System flowchart used to determine threat status categories (including 'Extinct', 'Vagrant', 'Migrant' 'Coloniser' and 'Data Deficient') (Townsend et al. 2008).



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Using the flowchart in Figure 5.1 and our current knowledge of leopard seals in New Zealand (Table 5.1), we assessed the threat status of this species in NZ waters (Table 5.1) and determined that they are a 'Resident' species.

Table 5.1: Assessment to determine if leopard seals in New Zealand are a 'Non-resident' or 'Resident' species (questions in the New Zealand Threat Classification System; Townsend et al. 2008).

Threat status questions (In Townsend. et al. 2008)	**Current knowledge** (Assessed by Hupman et al. 2019)	**Threat status assessment** (Assessed by Hupman et al. 2019)
"Is (or was) the taxon endemic or indigenous?"	Yes - Occurrence in New Zealand since the 1200s as evidenced by bones found in Maori middens (Smith 1985).	Does not meet criteria for 'Introduced or Naturalised'
"Is the name legitimately and effectively published and accepted? - add name to Taxonomically Determinate list"	Yes - Common English name; leopard seal. Scientific name *Hydrurga leptonyx*. Also see Rice (1998). Described by de Blainville (1820). Also see Rice (1998).	Meets criteria for assessment to proceed
"Is the taxon alive in the wild?"	Yes - As evidenced in the New Zealand Leopard Seal Database.	Does not meet criteria for 'Extinct'
"*Is the taxon regularly found in New Zealand and has failed to establish a resident breeding population*?	Yes - Regularly found year-round in all regions of New Zealand. No - as has established a resident breeding population (based on births – using criteria applied to other marine mammals by the NZTCS expert Panel)[1,2].	Does not meet criteria for 'Vagrant'
"*Does the taxon breed in New Zealand?*"	Yes - Established a resident breeding population (based on births - using criteria applied to other marine mammals by the NZTCS expert Panel)[1,2].	Does not meet criteria for 'Migrant'
"*Has the taxon arrived in New Zealand since 1950, without direct or indirect help from humans?*"	No - Occurrence in New Zealand since the 1200s as evidenced by bones found in Maori middens (Smith 1985).	Does not meet criteria for 'Coloniser'
Are the taxa 'data deficient?[3]	No - As evidenced by numerous publications and information in the NZLSD.	Does not meet criteria for 'Data Deficient'
Is the taxa resident?[2,3]	Yes - As evidenced in Hupman et al. 2019 and this table.	Meets the criteria for 'Resident'

[1] There is no definition of breeding in Townsend et al. (2008).

[2] See Footnote 4 in main text of Hupman et al. (2019) for explanation of the New Zealand Government Department of Conservation NZTCS Marine Mammal Expert Panel.

[3] Question inferred from flowchart in NZTCS (Townsend et al. 2008).

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