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Breeding success of little penguins (kororā, *Eudyptula minor*) in Wellington, 2014–2023: a first record of double brooding on North Island, New Zealand

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Abstract: Kororā, little penguin, breed in New Zealand and Australia with two subspecies now recognised after numerous taxonomic revisions: *Eudyptula minor minor* only in New Zealand, and *E.m. novaehollandiae*, in Australia and Otago on the southeast coast of South Island, New Zealand. One of the distinguishing features of *E.m. novaehollandiae* is the possible laying of a subsequent clutch by the same female after successfully fledging chicks (double brooding). In this study in Wellington, North Island, 25–53 nestboxes used for breeding were monitored for 10 years, 2014–2023 to determine abundance and breeding success. From the 380 clutches, 81% of eggs hatched, 87% of hatched chicks fledged, 70% of eggs fledged chicks, and 1.32 chicks fledged per clutch. Micro-chipping of adults from 2021 allowed identification of individuals at most locations. Double brooding was suspected prior to 2021 and was confirmed at one location in 2023. This is the first record of double brooding of kororā on the North Island. Genetic analysis of the female will resolve whether *E.m. minor* can double brood or if *E.m. novaehollandiae* has reached the North Island.

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INTRODUCTION

Little penguins kororā (*Eudyptula minor*) are the smallest extant penguin species and occur in southern Australia, New Zealand and their outlying islands (Marchant & Higgins 1990). Their taxonomic status has been repeatedly revised starting with the division into six subspecies based on morphology (Kinsky & Falla 1976). Further analyses of their morphology as well as biochemical blood analyses (Meredith & Sin 1988) resulted in the classification of all kororā as one species, *Eudyptula minor* (Checklist Committee 1990). Two different clades were identified based on mitochondrial DNA, morphology, and vocalisation—one consisting of Australian and Otago (south-east coast of South Island) kororā, and the other comprising the rest of New Zealand kororā (Banks *et al.* 2002). Despite further confirmation using genetic analyses (Overeem *et al.* 2008; Peucker *et al.* 2009), the species status remained unchanged with no subspecies recognised (Checklist Committee 2010). Grosser *et al.* (2015) suggested full species status for the Australian/Otago clade, based on the analysis of

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microsatellite markers, morphology, and other biological evidence, such as arriving ashore in groups as rafts (Daniel *et al.* 2007; H. Ratz pers. obs.), and the laying of a second clutch after successfully fledging the first, termed double brooding (Gales 1985) that had only been recorded in the Australian/Otago clade (Agnew *et al.* 2014; Grosser *et al.* 2015; Rowe *et al.* 2020). Subsequently, the taxonomic status was updated to two recognised subspecies: *E. minor novaehollandiae* in southern Australia (including Tasmania) and Otago, and *E. minor minor* in the rest of the New Zealand (Checklist Committee 2022).

Ancient DNA and radiocarbon dating revealed that no Australian/Otago kororā were present in New Zealand prior to human arrival, and the colonisation of southern New Zealand by Australian kororā occurred only a few centuries after the arrival of humans and coincided with the population decline of the New Zealand kororā clade (Grosser *et al.* 2016). It has been suggested that high productivity (by way of double brooding) may have given the Australian/Otago clade kororā an advantage over the New Zealand clade kororā and facilitated a rapid population expansion (Grosser *et al.* 2016) with evidence of some hybridisation found between Australian/Otago and New Zealand kororā in Oamaru (North Otago) and on Motunau Island (Canterbury, north of Christchurch) (Grosser *et al.* 2015; Peucker *et al.* 2009). There is evidence that a northward expansion may be continuing with double brooding now recorded at Kaikōura (Rowe *et al.* 2020).

Long-term monitoring of kororā breeding success is an essential tool to not just enumerate the population but to determine population trends and productivity. Around Wellington kororā have been monitored on Matiu-Somes Island (Kinsky 1960; Bull 2000); however, no records of their presence or abundance around the foreshores of Wellington city have been published, although kororā regularly feature in the media. 'Places for Penguins' is a project of the Wellington branch of the Royal Forest and Bird Protection Society of New Zealand Incorporated. Volunteers from the Wellington region contributed to this citizen science project in collaboration with the New Zealand Penguin Initiative to make their data publicly available. They have regularly monitored nestboxes along the coastline of Wellington city to determine kororā numbers and breeding success in order to inform conservation measures to protect kororā there. Here we report the breeding parameters and nestbox occupancy over ten seasons to enable future comparisons with kororā studies at these and other locations.

METHODS

This study started on the Wellington coastline (Fig. 1) in July 2014. Breeding seasons were allocated to the year they start (on 1 May), and they end on 30 April the following year. Nestboxes were monitored in ten kororā breeding locations from 2014: Balaena Bay (BB), Island Bay (IB), Kau Bay (KB), Mahanga Bay (MB), Moa Point (MP), Shelley Bay (SB), Tarakena Bay East (TBE), Tarakena Bay West (TBW), and Taputeranga Island (TI) (Fig. 1). Monitoring of nestboxes started at two further locations in 2015 (Evans Bay Marina = EBM and Greta Point = GP), and one location each in 2019 (NIWA) and 2021 (Owhiro Bay = OB) (Fig. 1). The total number of nestboxes (design based on Houston 1999) increased from 89 in 2014 to 149 in 2023 with 5–16 nestboxes at each location. Each nestbox was visited *c.* once a fortnight, and the number of adults and chicks were recorded until 2021, when weekly monitoring was initiated, except for Taputeranga Island (TI) where fortnightly monitoring continued because weather and access via kayak to the island made more frequent monitoring impractical.

Places for Penguins obtained a Wildlife Act Authority (Authorisation No. 47994-FAU) from the Department of Conservation for ten years in April 2016 to monitor nestboxes, and a variation was obtained in 2021 to mark kororā with passive integrated transponder (PIT) tags. Marking of adults and chicks that included weighing started in 2021 at four locations (KB, MP, TBE, and TBW) and was expanded to further five locations in 2022 (BB, EBM, GP, IB, and NIWA). Kororā at the remaining five locations remained unmarked.

Until the marking of kororā was initiated in 2021, nest contents were recorded passively without direct interaction with the penguins such as moving the adult aside to determine number of eggs in the nest, because volunteers had not been trained and certified for this method. The number of eggs was inferred from the number of chicks found during the post-guard stage and any unhatched eggs. From 2021, volunteers were taught how to carefully lift or

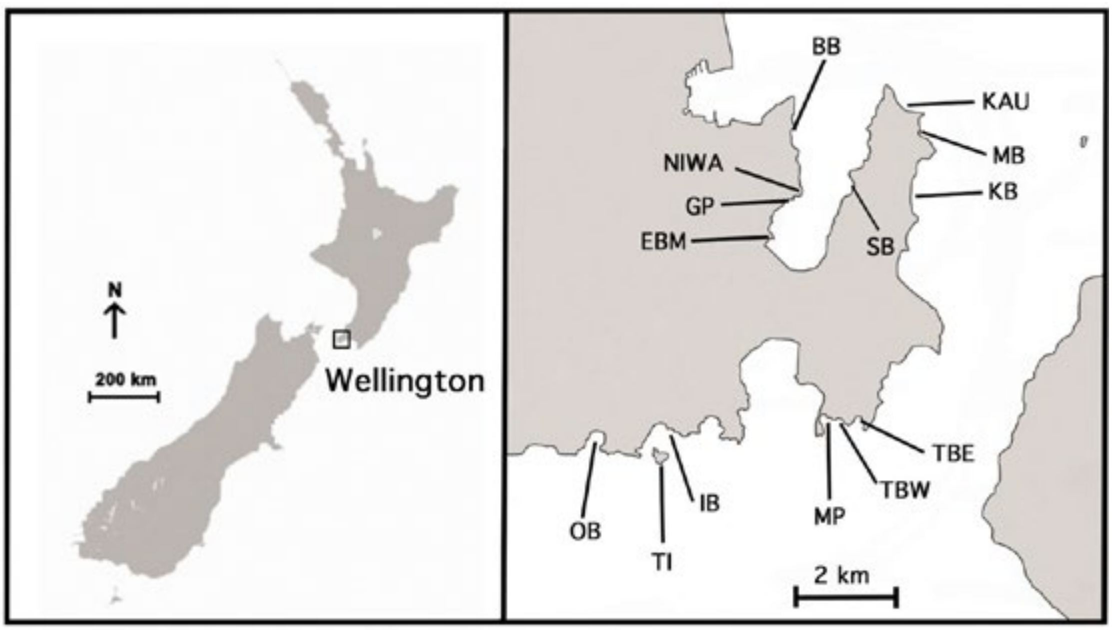

Figure 1. Map of New Zealand with the 14 locations where kororā nestboxes were monitored along the coastline of Wellington city.

Table 1. Number of clutches, females that bred, eggs laid, chicks hatched and chicks fledged from nestboxes monitored at Wellington from 2014 to 2023, together with hatching success (chicks hatched/eggs laid), fledging success (chicks fledged/chicks hatched), egg success (chicks fledged/eggs laid), and Chicks/clutch (chicks fledged per clutch), each followed by standard deviation (sd).

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Number of clutches	22	30	35	36	32	39	42	56	43	45
Number females bred	22	30	35	36	32	35	42	53	43	43
Number eggs laid	38	56	66	64	64	68	78	109	83	89
Number chicks hatched	32	45	50	59	49	58	73	79	65	68
Number chicks fledged	26	43	44	56	40	53	57	64	59	58
Hatching success	84% (0.06)	80% (0.05)	76% (0.05)	92% (0.03)	77% (0.05)	85% (0.04)	94% (0.03)	72% (0.04)	78% (0.05)	76% (0.05)
Fledging success	81% (0.07)	96% (0.03)	88% (0.05)	95% (0.03)	82% (0.06)	91% (0.04)	78% (0.05)	81% (0.04)	91% (0.04)	85% (0.04)
Egg success	68% (0.08)	77% (0.06)	67% (0.06)	88% (0.04)	63% (0.06)	78% (0.05)	73% (0.05)	59% (0.05)	71% (0.05)	65% (0.05)
Chicks/clutch	1.18 (0.73)	1.43 (0.73)	1.26 (0.74)	1.56 (0.65)	1.25 (0.84)	1.36 (0.81)	1.36 (0.58)	1.14 (0.86)	1.37 (0.79)	1.29 (0.87)

move the adult on the nest to be able to view the number of eggs in the nest, so that lay dates could be recorded.

Single clutches were defined as one clutch laid per nest; replacement clutches (RC) were defined as two or more clutches after the previous clutch had failed (to hatch or fledge); and double brooding (DB) was defined as a clutch laid after the first brood fledged successfully (Gales 1985; Agnew *et al.* 2014). Hatching success was defined as the number of chicks hatched from the number eggs laid; fledging success was defined as chicks fledged from the number of eggs that hatched; egg success was defined as the number of chicks fledged from the number of eggs laid; chicks/clutch was defined as the number of chicks fledged per clutch.

When microchipping started in 2021, adults and 6-week-old chicks were weighed to 10 g and fitted with 8 mm Trovan® microchips injected into the loose skin at the back of the neck. Adults were sexed by bill measurements of the exposed culmen and bill depth at the nostrils (following Renner & Davis 1999). Mate association was used when the known sex of one adult of a breeding pair was used to allocate or confirm the opposite sex to the mate. Sexing the adults provided confirmation of second clutches (replacement clutch or double brooding) for females. Prior to the start of microchipping, the number of females was inferred from the number of clutches, and if second clutches appeared in the same nestbox it was assumed to have been laid by the same female. Therefore, replacement clutches and double broods could not be determined with certainty prior to 2021. The number of clutches is correct, the number of females may be overestimated.

If only one chick was recorded in a nest and no second (unhatched) egg or chick was found, the clutch was recorded as only one egg, likely underestimating the total number of eggs laid, and overestimating hatching and egg success. If a chick disappeared (and the body was not found) at least 10 days prior to reaching fledging age (about 56 days) and the previous record indicated that it still had significant down coverage, it was assumed to have died rather than fledged successfully.

Data analysis

Inspection of all nest contents from 2021 allowed for calculation of mean lay dates and earliest lay dates of the first egg of the first clutch. It was assumed that three days elapsed between the laying of the first and second egg (Marchant & Higgins 1990; Kemp & Dann 2001). If there was no egg on the first visit, one egg on the second visit, and two eggs on the third visit, the earliest lay date for the first egg is three days prior to the second visit and the latest lay date is on the day of the second visit, therefore the mean lay date for this egg is 1.5 days prior the second visit, plus or minus 1.5 days. If there was no egg on the first visit and two eggs on the second visit, the earliest lay date for the first egg is the day of the first visit and the latest lay date for the first egg is three days prior to the second visit (with the latest lay date of the second egg on the day of the second visit). The mean lay date for the first egg is therefore halfway between the earliest and latest possible lay dates, plus or minus half the days that elapsed. If egg laying was not thus observed, lay dates for the first egg was calculated from hatch dates minus 38 days (35 days incubation plus three days between first and second egg).

Hatch dates were calculated as follows. If on the first visit the chicks had started to hatch by creating a hole in the shell, it was assumed that they hatched one day later plus or minus zero days (it takes one day or about 24 hours for a chick to fully hatch (H. Ratz, pers. obs.)). If on the first visit the eggs had no hole, and on the second visit chicks were present, the hatch date was taken to be halfway between the day after the first visit (to allow one day for hatching) and the day of the second visit, plus or minus half the days that had elapsed.

If a nest is discovered with chicks, hatch dates can be calculated from fledge dates by subtracting 56 days from the fledge date, which is the average time between hatching and fledging (Marchant & Higgins 1990). Fledging dates were calculated as follows. If the chicks were present on the first visit, but absent on the second visit, the earliest fledge date was the day after the first visit as they are assumed to depart in the morning. The latest fledge date is the day

Table 2. Lay dates of the first egg of the first clutch for single clutches, replacement clutches (RC) and double brooding (DB), plus or minus the days elapsed, standard deviation (sd), and the earliest lay date of the first egg of the first clutch.

Season	Clutch type	Number of locations	Number of first clutches	Lay date of first egg (mean +/- days elapsed (sd))	Earliest date of first egg
2021	Single	14	49	16 September +/- 3.4 days (17.6)	25 July
	RC	2	3	2 August +/- 4.8 days (18.6)	14 July
2022	Single	14	43	9 October +/- 2.3 days (16.7)	5 September
2023	Single	14	41	20 September +/- 2.3 days (17.5)	31 August
	RC	1	1	30 September +/- 1.5 days	30 September
	DB	1	1	5 July +/- 2.0 days	5 July

of the second visit. The mean date of fledging is therefore halfway between the earliest and latest date, plus or minus half the days that elapsed. Lay dates were calculated from fledging dates by subtracting 56 days and 38 days. All lay, hatch and fledge dates were rounded up to the nearest full date.

Proportions were treated as binomial distributions with the mean and standard deviation (sd) calculated following Zar (1999).

RESULTS

Only single clutches were laid at all locations in the first five seasons (2014–2018) and in 2020 and 2022 (Appendix). The number of clutches was higher than the number of females in the 2019, 2021 and 2023 seasons, indicating that some females laid more than one clutch (Table 1 & Appendix). In 2019, one replacement clutch was laid at one location (MP). Double brooding was likely in three nestboxes at three locations (MP, TBW and TI) but could not be confirmed because the adults were unmarked. In 2021, there were two replacement clutches at MP and one replacement clutch suspected at TI. In 2023, there was one replacement clutch at IB and double brooding in one nestbox at MP, both confirmed with marked females.

Over the ten seasons for all location combined, the mean hatching success was 80.8% (sd = 0.015, 578 chicks hatched / 715 eggs laid, range 72.5–93.6%); the mean fledging success was 86.5% (sd = 0.014, 500 chicks fledged / 578 chick hatched, range 78.1–95.6%); the mean egg success was 69.9% (sd = 0.014, 500 chicks fledged / 715 eggs laid, range 58.7–87.5%); and the mean number of chicks fledged per clutch was 1.32 (sd = 0.77, 500 chicks fledged / 380 clutches, range 1.14 – 1.56).

Lay dates of first eggs of first clutches were calculated for three seasons, 2021–2023, after weekly monitoring was initiated. First clutches that failed and were followed by replacement clutches were laid 6 weeks earlier than single clutches in 2021, but 10 days later in 2023 (Table 2). The female that subsequently double brooded laid the first egg in early July 2023 (Table 2).

Some but not all chicks were weighed and microchipped from 2021 at about 6 weeks old. While the highest mean weight for chicks from single clutches was recorded in 2023 (1047 g), the highest weight of a chick was recorded in 2022 (1310 g) and the lowest in 2021 (420 g) (Table 3). Chicks from the second clutch of the double brooding in 2023 were heavier than chicks from the first clutch (Table 3).

Approximately one third of the nestboxes were used for breeding each season (Table 4 & Appendix). A natural nest site was found and monitored at Moa Point in 2023.

DISCUSSION

Kororā (little penguins) are widely distributed and well-studied in Australia (e.g., results from 28 seasons (Dann *et al.* 2000) and 10 seasons (Fortescue 1999)) but in

Table 3. Mean body weights and mean ages of chicks microchipped in 2021, 2022 and 2023 from single clutches and replacement clutches (RC). Data for chicks from double brooding (DB) are shown separately for chicks from first and second clutches by the same female. Standard deviation (sd) shown in brackets.

Season	Clutch type	Number of chicks	Weight (g; mean (sd)	Minimum and maximum weights (g)	Age of chicks when weighed (days; mean (sd)	Minimum and maximum ages when weighed (days)
2021	Single	11	815 (227.5)	420 - 1220	44 (10.0)	37 - 52
	RC	1	950	950 - 950	47	47 - 47
2022	Single	35	992 (154.3)	690 - 1310	39 (3.5)	30 - 56
2023	Single	23	1047 (127.5)	820 - 1280	44 (6.2)	31 - 54
	DB - first	2	750 (0)	750 - 750	51 (0)	51 - 51
	DB - second	2	970 (14.1)	960 - 980	45 (0)	45 - 45

Table 4. Total number of nestboxes each year from 2014 to 2023, and the number and proportion used for breeding.

Season	Number of nestboxes	Number of nestboxes used	Proportion used
2014	89	25	0.28
2015	104	30	0.29
2016	107	36	0.34
2017	106	36	0.34
2018	113	32	0.28
2019	115	33	0.29
2020	129	42	0.33
2021	139	53	0.38
2022	144	43	0.30
2023	149	42	0.28

New Zealand results from long term studies have only been published from the Oamaru colony in North Otago (19 seasons; Agnew *et al.* 2014), Banks Peninsula (13 seasons; Allen *et al.* 2011) and Kaikōura (11 seasons; Rowe *et al.* 2020). Studies from other parts of New Zealand have been short term (e.g., two seasons in Wellington (Bull 2000), and one season on the West Coast of South Island (Heber *et al.* 2008)), leaving significant gaps in our knowledge of breeding biology for the New Zealand clade of kororā, *Eudyptula minor minor*.

There were relatively low numbers of kororā in nestboxes at each of the 14 locations in this study, with up to seven breeding females each year at mainland sites and up to 10 breeding females on Taputeranga Island. The largest number of breeding females in one year was 53, and so the population of kororā breeding along the Wellington city coastline can be considered to be significant. Approximately one third of the available nestboxes were used, a similar proportion to the 38% of nestboxes used in a study on the South Island West Coast (Heber *et al.* 2008) and lower than an occupancy rate of up to 75% on Banks Peninsula (Allen *et al.* 2011). Kororā breed in natural nest sites along the Wellington city coastline, as well as in nestboxes, and it appears that availability of nest sites is not limiting the size of the Wellington city kororā population.

In this 10-year study of kororā around the Wellington coast, volunteers from Places for Penguins recorded a relatively high breeding success with 1.14–1.56 chicks fledged per clutch over ten seasons (Table 1). Nearby on Matiu-Somes Island in Wellington harbour 0.77–0.78 chicks fledged per nest in the mid-1950s (Kinsky 1960) and 0.79–1.1 chicks fledged per nest in the mid-1990s (Bull 2000); neither study recorded double brooding.

The laying of a second clutch after successfully fledging chicks (double brooding; Gales 1985) has been suggested to be a characteristic behaviour for *E. m. novaehollandiae*, the Australian/Otago clade of kororā (Mickelson *et al.* 1992; Cullen *et al.* 2009; Agnew *et al.* 2014). However, the absence of reports of double brooding from other areas of New Zealand may be a consequence of the absence of monitoring studies of significant number of nestboxes over significant periods of time at locations outside Otago. Double brooding has recently been reported as far north as Kaikōura (Rowe *et al.* 2020). Results from the early seasons in our monitoring study indicated that double brooding was probably occurring in Wellington. This could not be confirmed until kororā were individually marked from 2021 onwards, with the first occurrence of confirmed double brooding on the North Island in 2023.

Kororā of the New Zealand clade lay replacement clutches but have not been recorded to double brood. The mean number of chicks fledged per female will be greater when double brooding occurs at a location, with reported values for mean number of chicks fledged higher in Otago studies than in studies of kororā at other locations. Double brooding has been recorded at Kaikōura, with an overall mean of 1.66 chicks fledged per pair in the study of Rowe *et al.* (2020). While there might be birds of the Australia/Otago clade at Kaikōura, the occurrence of double brooding at Kaikōura is not in itself evidence of this. Hybridisation has been detected between the two clades at Oamaru and Motunau Island (Grosser *et al.* 2015; Peucker *et al.* 2009) and little penguins can swim long distances (Dann *et al.* 1992; Priddel *et al.* 2008). A kororā banded at Oamaru arrived at Kaikōura, 370 km away, and bred for three seasons (Rowe *et al.* 2020) suggesting that expansion of Australian/Otago clade kororā and possible hybridisation may be occurring. The high productivity of kororā by way of double brooding (fledging up to four chicks per season) might give the Australian/Otago kororā an advantage over the New Zealand kororā as suggested by Grosser *et al.* (2016), and this could facilitate a population expansion for this clade.

Most kororā in Wellington are from the New Zealand clade and have not previously been recorded to double brood (Kinsky & Falla 1976; Bull 2000). There are two possible explanations for the double brooding we recorded. The double brooding birds in Wellington may indicate an expansion of the Australia/Otago clade, and double brooding may become more frequent outside Otago. Alternatively, the double-brooding females in Wellington are of the New Zealand clade and double brooding does occur in this clade but so rarely that it has not been recorded before. Double brooding in Australia is linked to high food availability (Mickelson *et al.* 1992; Cullen *et al.* 2009) and conditions in some years in Wellington may allow double brooding. Indeed, the number of chicks fledged per clutch in this study was still high (up to 1.56) indicating conditions in Wellington may be especially favourable for kororā in some years.

The only way to definitively identify the taxonomic identity of the double-brooding Wellington females would be by genetic testing. In the meantime, it is important that all studies reporting breeding success for comparisons between clades, areas and seasons use the same definitions of terms, so they are consistent and enable meaningful comparisons (Agnew *et al.* 2014).

At Oamaru, double brooding occurred in some years when first clutches were laid before mid-September (Agnew *et al.* 2014). In this study, the mean lay dates for the first egg were typically between mid-September and mid-October for single clutches, and earlier for pairs that subsequently laid a replacement clutch or double brooded (Table 2). In the mid-1950s, first eggs were laid on Matiu-Somes Island in August (Kinsky 1960), and late July on the West Coast of South Island in 2006 (Heber *et al.* 2008), suggesting that double brooding is possible, though not recorded. In Kaikōura, the earliest lay date for females that subsequently double brooded was 23 May, with the mean lay date for these females 7 August (Rowe *et al.* 2020). Onset of egg laying is determined by food availability (Hobday

1992; Chiaradia & Kerry 1999) as well as the occurrence of storms that can delay onset of breeding or cause breeding failure (Agnew *et al.* 2013). The diet of kororā in Wellington is unknown, as is the effect of storms on the onset of breeding.

While the onset of egg laying can be indicative of food availability (Hobday 1992; Chiaradia & Kerry 1999), and chick weights are related to fledging success (Agnew *et al.* 2014), parents can also adapt their foraging behaviour to compensate for a food shortage (Chiaradia & Nisbet 2006). In this study, the 2023 season had the highest mean weight of 6-week-old chicks from single clutches as well as the occurrence of double brooding, suggesting high food availability that season.

Citizen science, as defined by the Oxford English Dictionary as scientific work undertaken by members of the public, often in collaboration with or under the direction of professional scientists and scientific institutions, is becoming more widespread around the globe and can play an important part in conservation (Gura 2013). This study illustrates how more than 80 volunteers involved with Places for Penguins who were trained to collect valuable data about population size, trends and breeding parameters of kororā in Wellington, led to the discovery of new information about their breeding behaviour. Their involvement enables other conservation organisations, as well as local and central government agencies to improve on conservation and protection measures to ensure the future presence of species like kororā on our shorelines.

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APPENDIX

Breeding data for 14 locations in Wellington, 2014 – 2023, with clutch type (single clutch, replacement clutch (RC), double brooding (DB) and the total of all clutches in a season), number of clutches and number of females that bred. The number of eggs laid, number of chicks hatched and fledged was used to calculate hatching success, fledging success, and reproductive success (Table 2). The number of nestboxes are all nestboxes available to kororā at each location each season with all but one pair at Moa Point (MP) in 2023 using nestboxes. Number of nestboxes used is the number used for breeding.

Location	Season	Clutch type	Number clutches	Number females bred	Number eggs laid	Number chicks hatched	Number chicks fledged	Number nestboxes	Number nestboxes used
BB	2014	Single	3	3	5	5	5	5	3
	2015	Single	3	3	6	6	6	5	3
	2016	Single	3	3	5	2	2	7	3
	2017	Single	3	3	5	5	5	7	3
	2018	Single	2	2	4	4	4	7	2
	2019	Single	1	1	1	1	0	6	1
	2020	Single	1	1	2	2	2	6	1
	2021	Single	1	1	2	2	2	6	1
	2022	Single	1	1	2	2	1	6	1
	2023	Single	1	1	2	0	0	8	1
EBM	2015	Single	1	1	2	2	0	5	1
	2016	Single	1	1	2	2	1	5	1
	2017	Single	1	1	2	2	1	5	1
	2018	Single	1	1	2	2	2	5	1
	2019	Single	1	1	2	2	2	7	1
	2020	Single	3	3	6	5	2	7	3
	2021	Single	5	5	10	7	7	6	5
	2022	Single	5	5	10	9	7	10	5
	2023	Single	5	5	10	9	5	10	5
GP	2015	Single	0	0	0	0	0	10	0
	2016	Single	0	0	0	0	0	6	0
	2017	Single	1	1	2	2	2	6	1
	2018	Single	1	1	2	2	0	6	1
	2019	Single	1	1	2	2	2	6	1
	2020	Single	1	1	2	2	1	6	1
	2021	Single	2	2	4	4	4	6	2
	2022	Single	1	1	2	1	1	6	1
	2023	Single	1	1	2	2	2	6	1

Location	Season	Clutch type	Number clutches	Number females bred	Number eggs laid	Number chicks hatched	Number chicks fledged	Number nestboxes	Number nestboxes used
IB	2014	Single	2	2	3	3	3	11	2
	2015	Single	2	2	4	3	3	11	2
	2016	Single	4	4	7	4	4	11	4
	2017	Single	3	3	5	4	3	11	3
	2018	Single	1	1	2	1	1	11	1
	2019	Single	1	1	2	2	2	11	1
	2020	Single	2	2	4	4	2	11	2
	2021	Single	6	6	11	7	4	12	6
	2022	Single	4	4	8	8	8	12	4
	2023	Single	5	5	10	4	4	13	5
		RC	2	1	4	0	0		1
		total	7	6	14	4	4	13	6
KAU	2014	Single	3	3	6	5	5	10	3
	2015	Single	3	3	5	5	5	10	3
	2016	Single	4	4	8	4	4	11	5
	2017	Single	3	3	6	6	5	10	3
	2018	Single	4	4	8	8	7	12	4
	2019	Single	6	6	9	8	8	12	6
	2020	Single	5	5	10	9	8	12	5
	2021	Single	5	5	10	10	10	12	5
	2022	Single	4	4	8	5	5	12	4
	2023	Single	3	3	6	6	4	12	3
KB	2014	Single	2	2	4	3	3	5	2
	2015	Single	2	2	4	4	4	5	2
	2016	Single	2	2	4	3	3	5	2
	2017	Single	2	2	4	4	4	5	2
	2018	Single	2	2	4	3	2	7	2
	2019	Single	1	1	2	2	2	8	1
	2020	Single	2	2	4	3	3	8	2
	2021	Single	2	2	4	4	2	9	2
	2022	Single	3	3	6	6	6	9	3
	2023	Single	1	1	2	2	0	9	1
MB	2014	Single	2	2	4	3	2	10	2
	2015	Single	2	2	3	2	2	10	2
	2016	Single	1	1	2	2	2	10	1
	2017	Single	0	0	0	0	0	10	0
	2018	Single	2	2	4	4	3	10	2
	2019	Single	2	2	4	4	3	10	2
	2020	Single	1	1	2	2	1	10	1
	2021	Single	1	1	2	2	1	10	1
	2022	Single	2	2	3	1	0	10	2
	2023	Single	3	3	6	6	4	10	3

Location	Season	Clutch type	Number clutches	Number females bred	Number eggs laid	Number chicks hatched	Number chicks fledged	Number nestboxes	Number nestboxes used
MP	2014	Single	0	0	0	0	0	10	0
	2015	Single	2	2	3	3	3	10	2
	2016	Single	4	4	7	6	5	10	4
	2017	Single	6	6	10	9	9	10	6
	2018	Single	5	5	10	4	4	10	5
	2019	Single	3	3	6	6	6	10	3
		RC	2	1	4	4	2		1
		DB	2	1	4	4	4		1
		total	7	5	14	14	12	10	5
	2020	Single	5	5	10	9	7	10	5
	2021	Single	3	3	6	5	4	10	3
		RC	4	2	8	4	1		2
		total	7	5	14	9	5	10	5
	2022	Single	5	5	10	6	6	11	5
	2023	Single	6	6	12	11	11	13	5
		DB	2	1	4	4	4		1
		total	8	7	16	15	15	14	6
NIWA	2019	Single	2	2	4	4	4	13	2
	2020	Single	3	3	6	6	4	13	3
	2021	Single	4	4	7	3	2	13	4
	2022	Single	3	3	5	2	2	13	3
	2023	Single	3	3	6	2	2	13	3
OB	2021	Single	1	1	1	0	0	8	1
	2022	Single	1	1	2	2	2	8	1
	2023	Single	1	1	2	2	2	7	1
SB	2014	Single	3	3	4	3	2	10	3
	2015	Single	2	2	4	3	3	10	2
	2016	Single	2	2	4	4	3	10	2
	2017	Single	2	2	3	3	3	10	2
	2018	Single	1	1	2	2	1	10	1
	2019	Single	0	0	0	0	0	10	0
	2020	Single	2	2	3	3	2	10	2
	2021	Single	3	3	6	6	6	10	3
	2022	Single	3	3	6	6	4	10	3
	2023	Single	2	2	4	2	2	10	2
TBE	2014	Single	3	3	4	4	4	10	3
	2015	Single	3	3	5	5	5	10	3
	2016	Single	3	3	5	3	3	10	3
	2017	Single	4	4	8	6	6	10	4
	2018	Single	3	3	6	4	4	10	3
	2019	Single	4	4	7	4	4	10	4
	2020	Single	4	4	7	7	6	10	4
	2021	Single	4	4	8	4	4	10	4
	2022	Single	2	2	4	4	4	10	2
	2023	Single	1	1	2	2	2	10	1

Location	Season	Clutch type	Number clutches	Number females bred	Number eggs laid	Number chicks hatched	Number chicks fledged	Number nestboxes	Number nestboxes used
TBW	2014	Single	1	1	2	2	0	10	3
	2015	Single	4	4	8	4	4	10	4
	2016	Single	3	3	6	6	5	10	3
	2017	Single	4	4	5	4	4	10	4
	2018	Single	2	2	4	4	4	11	2
	2019	Single	2	2	2	1	1	11	2
		DB	2	1	4	3	3		1
		total	4	3	6	4	4	11	3
	2020	Single	4	4	7	6	5	11	4
	2021	Single	4	4	8	6	4	11	4
	2022	Single	1	1	2	2	2	11	1
	2023	Single	2	2	3	2	2	11	2
TI	2014	Single	3	3	6	4	2	8	4
	2015	Single	6	6	12	8	8	8	6
	2016	Single	8	8	16	14	12	12	8
	2017	Single	7	7	14	14	14	12	7
	2018	Single	8	8	16	11	8	14	8
	2019	Single	7	7	12	8	7	14	7
		DB	2	1	3	3	3		1
		total	9	8	15	11	10	14	8
	2020	Single	9	9	15	15	14	15	9
	2021	Single	9	9	18	13	11	16	9
		RC	2	1	4	2	2		1
		total	11	10	22	15	13	16	10
	2022	Single	8	8	15	11	11	16	8
	2023	Single	7	7	14	14	14	16	7