



PHILLIP ISLAND (MILLOWL) BEACH NESTING SHOREBIRD BREEDING 2021/22 END OF SEASON REPORT

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Milowl is the Bunurong name for Phillip Island. It is part of the country recognised as being the traditional land and waters of the Bunurong and is steeped in cultural history dating back tens of thousands of years. We acknowledge the Traditional Owners of the land on which we live, work and learn, the Bunurong. We pay our respects to their Elders past, present and emerging.

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Summary

The 2021/2022 hooded plover breeding season marked the 30th season of monitoring on Phillip Island (Millowl) with 944 entries into the MyBeachBird portal by Phillip Island Nature Parks staff, Bass Coast Shire Council staff and volunteers. Nineteen pairs of hooded plovers (*Thinornis cucullatus cucullatus*) bred in the 2021/2022 breeding season on Phillip Island (Millowl), which is consistent with previous years, they made 29 nests which contained 70 eggs and produced 25 chicks. Fourteen chicks survived to fledge successfully from 12 nests, which is the second highest number in recorded history, the highest being 17 fledged in the 2015/16 season. This produced a fledged per pair of 0.74 which is the third highest season on record after 0.94 in 2015/16 and 0.75 in 2014/15 indicating a high level of breeding success. For a detailed summary, see Table 1.

At least three pairs of pied oystercatchers (*Haematopus longirostris*), one pair of sooty oystercatchers (*Haematopus fuliginosus*) and one breeding colony (10 individuals) of red-capped plover (*Charadrius ruficapillus*) were also recorded in the 2021/22 breeding season. Two red-capped plover chicks were suspected to have fledged, however, no chicks or fledglings were confirmed for pied oystercatchers or sooty oystercatchers, which may have been due to a lack of monitoring effort. See Appendix C for a detailed summary. No breeding activity was recorded for fairy terns (*Sternula nereis*) on Phillip Island (Millowl) in 2021/22.

Variable	2021/22	2020/21	2017-22 average	2012-17 average
First nest	05/09/2021	31/08/2020	26/09/2017	01/10/2012
Last nest	24/02/2022	12/02/2021	24/02/2022	07/03/2017
No. nests	29	46	40.4	31.6
No. eggs	70	101	94.6	72.8
No. chicks	25	28	31.8	29.2
No. fledglings	14	11	11	10.8
No. breeding pairs	19	18	20	17.2
Av. eggs per nest	2.41	2.2	2.34	2.3
Av. nests per pair	1.53	2.56	2.02	1.84
No. nests hatched	12	14	14.2	12.6
Egg to chick survivorship	35.71%	27.72%	33.62%	40.11%
Chick to fledge survivorship	56%	39.29%	34.59%	36.99%
Egg to fledge survivorship	20%	10.89%	11.63%	14.84%
Eggs per clutch	2.41	2.2	2.34	2.3
Fledged per clutch	0.48	0.24	0.27	0.34
Fledged per pair	0.74	0.61	0.55	0.63

Table 1: Summary statistics for this hooded plover breeding season (2021/22), the previous season (2020/21), and mean values for the 2012-17 and 2017-22 periods.

Volunteer activities

Volunteering activities recommenced in a limited capacity for the 2021/22 breeding season, with a total of 172.84 volunteer hours (Table 2). Volunteer activities included monitoring nesting pairs, portal entries and participating in the ‘hooded plover and gull count’. The nest guardian role and other public interactions were discontinued to comply with Covid restrictions. Though this was an increase on the 2020/21 season, it is still a significant reduction from previous years due to the COVID-19 pandemic and resulting suspension of volunteer activities across the Nature Parks. Volunteers, excluding interns, contributed 32% (303 out of 944) of the MyBeachBird portal entries this season (Figure 1). Volunteers’ contributions allow us to prioritise our monitoring efforts and plays an invaluable role in beach nesting shorebird monitoring and management. Phillip Island Nature Parks would like to thank and commend volunteers for their personal contributions to conservation efforts throughout the 2021/22 breeding season.

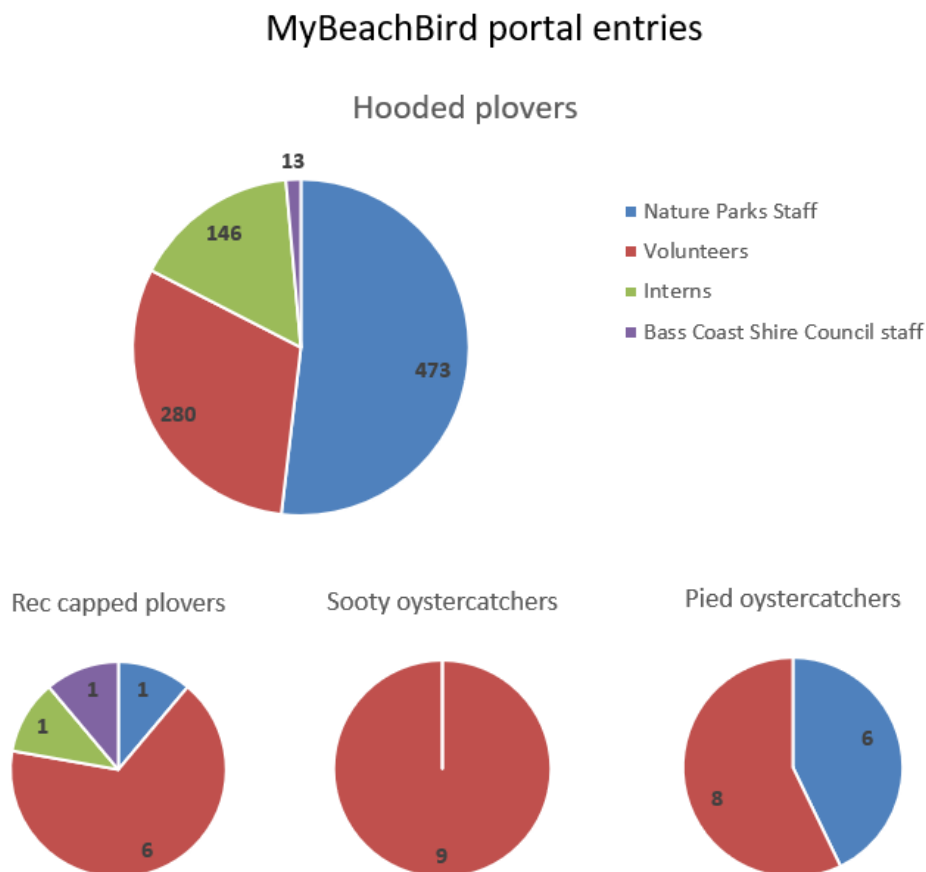


Figure 1: Number of MyBeachBird portal entries by species and contributors.

Internships and camera Trap study

The camera trapping study commenced in the 2020/21 season and was continued for the 2021/22 breeding season with the aim of further clarifying causes of hooded plover nest failures. Four (of a potential five) cameras were deployed by Phillip Island Nature Parks intern, Alan Cheung, to monitor nests during the breeding season. Cameras were deployed at four nest sites: Kitty Miller Bay, Berrys Beach centre, Woolshed Bight and Colonnades West. A key aim of this study was to assess the efficacy of camera trapping to better ascertain the reason(s) for nesting failure. This season cameras failed to capture any direct evidence of nest failure but did show predator activity at nest sites that correlated with the disappearance of eggs. Cameras also caught instances of natural events such as tidal inundation, rain events, refuge intrusion and successful guarding behaviours from the adults. Unfortunately, Alan couldn't start before mid-December therefore missing early nesting with the first camera deployed on nest 17 on 12/01/22. It is recommended that all five cameras allowable are deployed evenly across the breeding season to optimise data collection opportunities for subsequent breeding seasons.

Activity	2021/22	2020/21	2019/20	2018/19	2017/18
Monitoring	138.31	75.81	422.76	--	--
Guardian	--	--	250.92	--	--
Counts	34.53	6.5	49.50	--	--
Community Engagement Events	--	--	25.5	--	--
Internship*	228.90	205.25	261.50	--	--
Deployment*		382.5	--	--	--
Total	172.84	82.31	748.68	454.55	407

* not included in total volunteer hours

Table 2: Summary of hooded plover related volunteering activity hours for the 2017/18 – 2021/22 breeding season.

Cameras collected 5,325 images over 214 days, many of these images did not contain useful information as vegetation or other natural movement triggered the camera, more careful placement next season will hopefully prevent this issue; 461 images contained Australian magpies (*Cracticus tibicen*), (n=101) and ravens (*Corvus sp.*) (n=360) in and near the refuges, and 20 separate refuge intrusions occurred while the hooded plovers were actively breeding — eleven when they had chicks and nine when they had nests with eggs. For six of those nine, the parents responded to the intrusion by leading the magpie/raven away, exhibiting their broken wing display, or by flying at the intruder (Table 3). No interactions between predators and hooded plovers while chicks were present were captured, this is likely due to chicks being able to move out of frame. The intrusions of ravens in the days leading up to us finding the eggs missing at Berrys Beach centre led us to suspect ravens as the cause of failure of that nest (Figure 2).



Figure 2: Image of a raven (*Corvus* sp.) next to a hooded plover nest (circled in red) captured on a camera trap at Berrys Beach centre.

Location	Date	Time	Intruder type	Breeding status	Hooded plovers' response
Kitty Miller Bay	13/01/2022	8:57am	raven	nest with eggs	Broken wing display
Kitty Miller Bay	14/01/2022	12:39:pm	magpie	nest with eggs	Parents leave nest
Kitty Miller Bay	22/01/2022	9:11am	raven	nest with eggs	Broken wing display
Kitty Miller Bay	24/01/2022	9:05am	raven	nest with eggs	Broken wing display
Kitty Miller Bay	25/01/2022	9:24am	raven	nest with eggs	Broken wing display
Kitty Miller Bay	04/02/2022	10:02am	raven	chicks	None captured
Kitty Miller Bay	05/02/2022	2:36pm	magpie	chicks	None captured
Kitty Miller Bay	08/02/2022	10:15am	raven	chicks	None captured
Kitty Miller Bay	12/02/2022	9:00am	raven	chicks	None captured
Kitty Miller Bay	13/02/2022	8:17am	raven	chicks	None captured
Kitty Miller Bay	14/02/2022	8:52am	raven	chicks	None captured
Kitty Miller Bay	24/02/2022	3:38pm	raven	chicks	None captured
Kitty Miller Bay	26/02/2022	2:08pm	magpie	chicks	None captured
Colonnades west	07/03/2022	8:17am	magpie	nest with eggs	Parents defend nest
Colonnades west	18/03/2022	3:15pm	raven	chicks	None captured
Colonnades west	24/03/2022	8:43am	magpie	chicks	None captured
Colonnades west	29/03/2022	1:56pm	magpie	chicks	None captured
Berrys Beach centre	16/01/2022	9:55am	magpie	nest with eggs	None captured
Berrys Beach centre	24/01/2022	9:28am	magpie	nest with eggs	None captured
Berrys Beach centre	29/01/2022	11:45am	magpie	nest with eggs	None captured

Table 3: Summary table of predator intrusions captured by camera traps in the 2021/22 breeding season.

Hooded plover breeding season 2021/22

Nesting outcomes

During the 2021/22 season, 19 breeding pairs made 29 nests with a total of 70 eggs laid in these nests between 05/09/2021 and 24/02/2022 (Table 1). Nests with eggs were distributed across 19 nesting sites on the island, with 12 of those sites producing chicks, and 7 of those sites successfully producing fledglings (Figure 3).

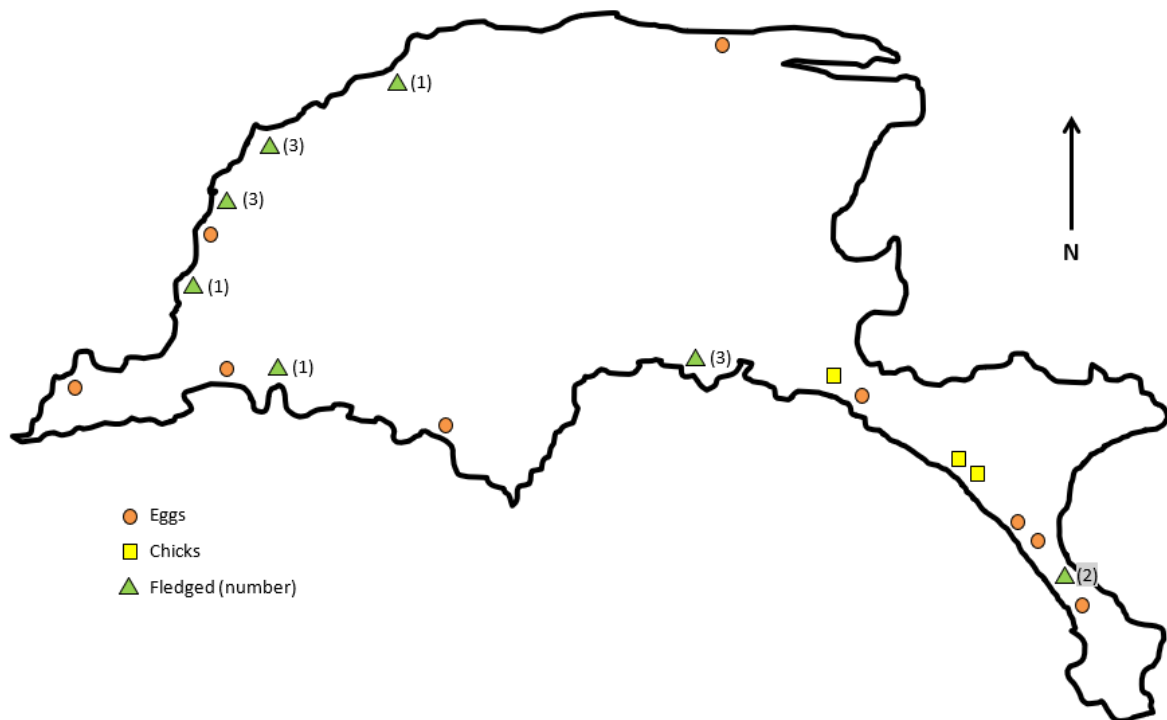


Figure 3: Summary map of hooded plover nesting sites (n=19) distributed on Phillip Island (Millowl) and the breeding outcome at each site (eggs, chicks, or fledged).

The 2021/22 season follows the desired trend heading towards what would be an ideal breeding season for hooded plovers on Phillip Island (Millowl): a high proportion of eggs laid surviving to successfully fledge. Figure 4 demonstrates an initial increase of breeding pairs, nests, egg and chicks, but no increase in fledglings between 1992-97 and 2007-12 periods; 2012-17 onwards shows overall decreasing number of nests and eggs with increasing chicks and fledglings as well as increasing fledged per pair. This is indicative of a greater rate of breeding success, less nesting effort resulting in successful fledglings. For a more detailed overview of hooded plover breeding over time see the further reading at the end of this report.

Where required, egg floating was also employed to determine the age of clutches that were found after the fact. Throughout the 2021/22 breeding season, 13 hooded plover eggs were floated from five nests. The average age of eggs when floated was 17.2 days (12-22 days). Two of the nests failed, however for the three nests that went on to produce chicks, egg float improved the prediction of hatch date (7 to 3 days, 8 to 1 day and 6 to 1 day). The benefits of this are that chick protection measures (signage, chick shelters, extended refuge areas and monitoring efforts) could be deployed ahead of the actual hatch date.

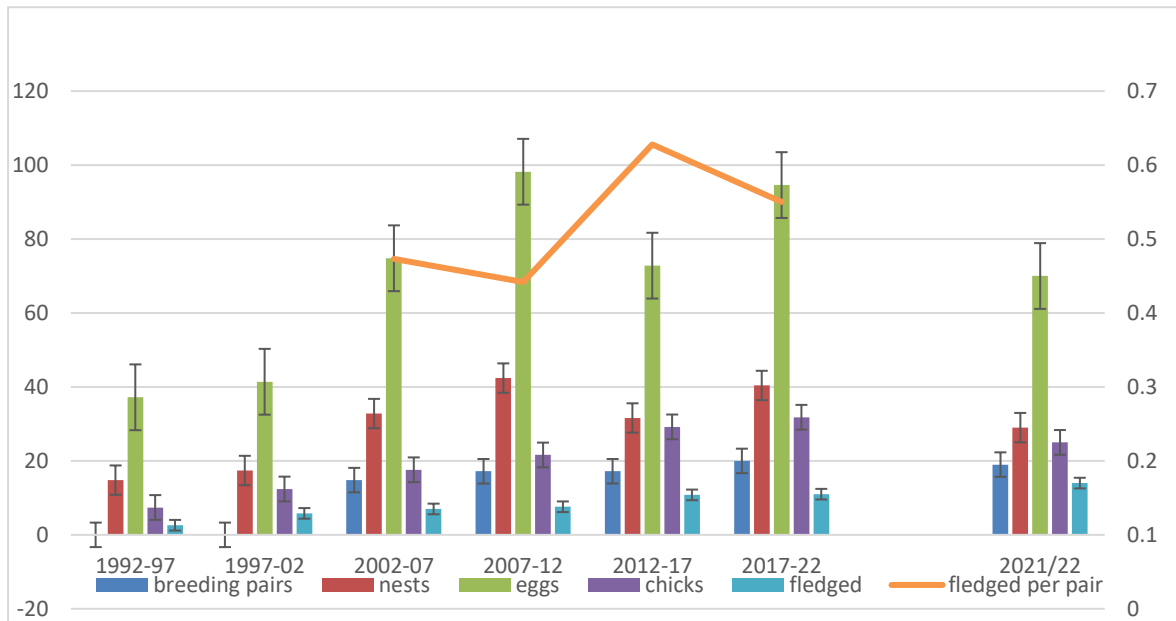


Figure 4: Five-year breeding season averages for breeding metrics of hooded plovers on Phillip Island (Mallow) 1992 – 2022, and the most recent 2021/22 seasons breeding metrics data. Note: number of breeding pairs were recorded from 2002/3 onwards.

Nest and chick failures were categorised based on evidence found at the nest site. Sometimes failures occurred at multiple stages, for example: Nest 25 at Crazy Birds east, one egg was suspected to be added during an egg float, another egg failed due to unknown causes, and one chick also failed due to unknown causes. The loss of multiple eggs or chicks at a location was categorised as one failure event unless there was evidence to suggest otherwise. There were 32 recorded failure events (24 for eggs and 8 for chicks) and they consisted of unknown causes (n = 20), suspect raven/magpie predation (n = 6) as well as suspect severe weather/tidal events (n = 3) (Figure 5). Suspected events were based on any remaining evidence found at the nesting site post nest failure as well as camera trap footage. It is important to note the limitations of this evaluation; there can be multiple factors causing failures. Foraging time has been found to decrease as well as the level of the habitat used for foraging changed with increasing levels of disturbance (Weston, 2000) which could make them more

vulnerable to predation and weather events. See Appendix A for the nesting site and failure event summary.

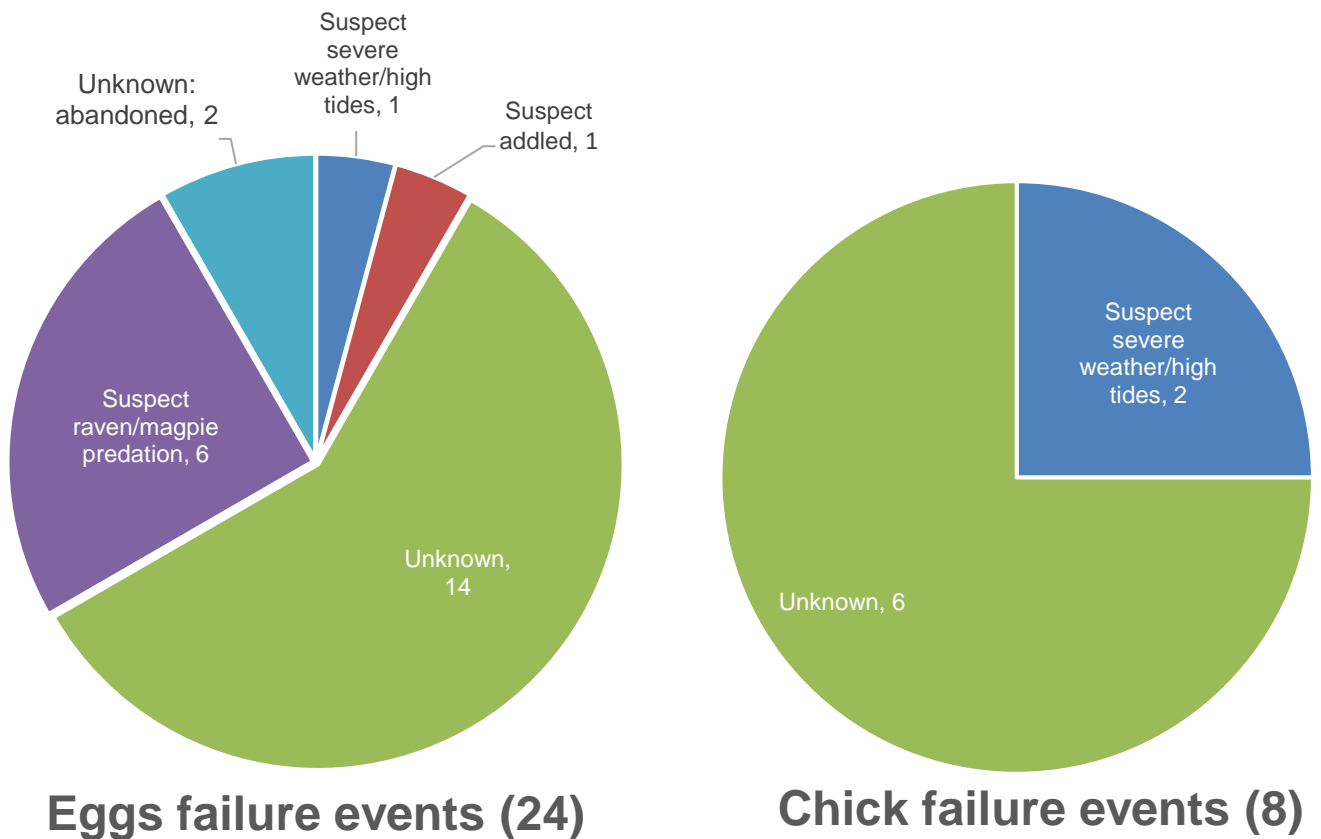


Figure 5: Causes of hooded plover failure events for eggs and chicks during the 2021/22 breeding season.

Fledging outcomes

During the 2021/22 breeding season 25 chicks hatched from 19 nesting sites and 14 chicks successfully fledged from 7 of those nesting sites (Figure 3). For the 2021/22 season egg to chick survivorship was 35.71%, slightly higher than the 2020/21 season (27.72%) which is consistent with the 2017-22 average of 33.62% lower than the average 40.11% for the 2012-17 period (Table 1). This trend in lower egg to chick survivorship indicates an area to focus management strategies to improve egg to chick survivorship. It is worth noting, however, that chick to fledging survivorship for was 56% which is a huge increase from 39.29% and 34.59% for the 2020/21 season and 2017-15 period respectively. The egg to fledging survivorship was 20% which is the highest number ever recorded (Table 1, Appendix D). This increase could be attributed to the back-to-back La Niña events resulting in higher ocean productivity and increased food availability for the hooded plovers.

Banding and flagging

Throughout the 2021/22 breeding season, a total of 12 chicks were caught, biometrically measured, banded, given a unique leg flag and had feather samples taken for sexing. See Table 3 below for a summary of their details. A total of 37 banded adults were recorded through quarterly hooded plover counts and the MyBeachBird portal over the season, 13 (35%) of those were originally flagged and banded off Phillip Island from other parts of Victoria and 10 (27%) of them were banded in the 2020/21 season (Appendix C). The relatively high success rates of Phillip Island (Mallowl) outlined above position the region as a fledgling source for the rest of Victoria. This is confirmed by the presence of Phillip Island (Mallowl) leg flags appearing in other regions.

The chick who defied expectations

There was one chick that wasn't expected to survive due to being visibly smaller than its siblings. The size difference was first noticed when the chicks from Nest 26: Woolshed Bight were an estimated 14 days old, they were then monitored a minimum of once a week until they were banded (~31 days old). During banding this chick (flagged 4A) was underweight at 42g compared to its siblings at 56g and 61g (Table 4). At an estimated 39 days old the other two chicks successfully fledged while the smaller chick did not. The chick was not sighted for a period, and was assumed to have not survived, but was sighted again – having successfully fledged between 39 and 49 days old (Figure 6).



Figure 6: Woolshed bight chicks through the telescope and being released after banding. Photo A showing chicks at ~14 days old, 4A is the smaller chick on the right. Photo B showing chicks at ~31 days old with 4A in the middle.

Date	Nesting site	Band no.	Band location	Leg flag details	Flag location	Bird status	Weight (g)	Notes
18/01/2022	Anchorage Rd	05268685	Left tarsus	Yellow 93	Left tibia	Chick	48	
02/02/2022	Smiths Beach Far East	05268686	Left tarsus	Yellow 95	Left tibia	Chick	71	
02/02/2022	Smiths Beach Far East	05268687	Left tarsus	Yellow 96	Left tibia	Chick	70	
02/02/2022	Smiths Beach Far East	05268688	Left tarsus	Yellow 97	Left tibia	Chick	66	
02/02/2022	Ventnor Devon Ave	05268689	Left tarsus	Yellow 98	Left tibia	Chick	48	
02/02/2022	Ventnor Devon Ave	05268690	Left tarsus	Yellow 99	Left tibia	Chick	53	
02/02/2022	Ventnor Devon Ave	05268691	Left tarsus	Yellow 1A	Left tibia	Chick	51	
04/03/2022	Kitty Miller Bay	05268692	Left tarsus	Yellow 1B	Left tibia	Chick	73	
24/03/2022	Colonnades	05268693	Left tarsus	Yellow 2A	Left tibia	Chick	63	Did not successfully fledge
24/03/2022	Woolshed bight	05268694	Left tarsus	Yellow 3A	Left tibia	Chick	56	
24/03/2022	Woolshed bight	05268695	Left tarsus	Yellow 4A	Left tibia	Chick	42	Significantly smaller chick
24/03/2022	Woolshed bight	05268696	Left tarsus	Yellow 5A	Left tibia	Chick	61	

Table 4: Summary of hooded plover chick band and flag details of the 2021/22 season.

Pied oystercatcher breeding season 2021/22

Limited data were collected for pied oystercatchers on Phillip Island (Millowl) for the 2021/22 breeding season, with only 14 of the 944 MyBeachBird portal entries (Figure 1). At least three pairs were recorded nesting across Observation Point. At least five eggs were laid across the three nests. It is uncertain how many chicks in total were produced. No banding or flagging was conducted. See Appendix B for a detailed summary.

Sooty oystercatcher breeding season 2021/22

Limited data were collected for sooty oystercatchers on Phillip Island (Millowl) for the 2021/22 breeding season, with only nine out of the total 944 MyBeachBird portal entries (Figure 1). At least one pair was recorded nesting on Silverleaves (Dolphin Drive) where at least one egg was laid. It is uncertain how many chicks in total were produced. No fledglings were sighted throughout the breeding season and no chicks were banded or flagged. See Appendix B for a detailed summary.

Red-capped plover breeding season 2021/22

Limited data were collected for red-capped plovers on Phillip Island (Millowl) for the 2021/22 breeding season, with only nine MyBeachBird portal entries out of the total 944 (Figure 1). At least one pair was recorded nesting on Silverleaves (Dolphin Drive) where at least two eggs were laid; two chicks and two juveniles were sighted along a timeline that could indicate these eggs surviving to fledge but that cannot be confirmed. See Appendix B for a detailed summary.

Fairy tern breeding season 2021/22

Although fairy terns (*Sternula nereis*) were recorded on 10 occasions at Observation Point between 05/10/21 and 13/01/22 with a maximum of 23 birds on 21/12/21 no breeding was recorded again this season, unlike the successful 2019/20 season. It is not clear why they did not breed as behaviour such as landing in the dune, courtship display flights, and birds harassing when observer went near the previously used nesting area indicated a potential. Throughout the 2020/21 and the 2021/22 breeding seasons Observation Point experienced a higher level of tidal inundation due to topographical changes compared to the previous season perhaps limiting the ability for nesting shorebirds to successfully nest in the area. Marram grass has also taken over much of the previous nesting site.

Recommendations

Hooded plovers

- Considering the lower egg to chick survival rate (33.62%) for the 2021/22 hooded plover breeding season as compared to the 2012-17 period average (44.11%), it is recommended that more rigorous nest monitoring occurs in following seasons to determine the causes of egg failure which remain largely unknown (Figure 5).
- Data from the nest camera trap study over the past two years demonstrated the efficacy and validity of remote camera traps at nesting sites to capture evidence of nest failure causes. This evidence supports proactive predator management, which has been noted as a useful management strategy in the past. It is recommended that this study continues along with opportunities for interns to participate.
- Partnering with RMIT University, a social research study was initiated in 2019 to better understand compliance behaviours and motivations of beach users across Phillip Island (Mallowl). This behavioural science study may assist in targeted management and campaign decisions in future. It is recommended that the study continues once it is safe to do so, with Phillip Island Nature Parks interns driving the research.
- Identifying the causes of hooded plover chick failure remains an important yet difficult task (Lees et al. 2019). Despite the difficulties in definitively determining chick failure causes, it should remain a high priority for staff and volunteers into the future to be extra attentive whilst chicks are around. Frequent checking of nest sites where chicks are active is imperative, and where it is suspected a chick has failed, extra attention to details/evidence/tracks should be exercised around the area and any/all data recorded in the Birdlife portal.
- The Birdlife MyBeachBird portal remains a vital tool in the management of Phillip Island's (Mallowl's) hooded plover population. All portal entries by staff and volunteers during the 2021/22 breeding season were invaluable and the authors express our deepest thanks for their efforts. Threat related data are vital to the tailoring of management strategies implemented for Phillip Island's hooded plover population, so it is recommended that training days are organised by the Nature Parks or Birdlife staff for all people who use the Birdlife portal to reiterate the importance of collecting these data and what to record.
- Replace pest plants at key hooded plover breeding sites with appropriate native species.

Other nesting shorebird species

- It is unknown if or how the effects of climate change are impacting pied oystercatcher, sooty oystercatcher and red-capped plover nesting behaviours or recruitment on Phillip Island (Mallowl). Furthermore, the current extent and status of their populations on the island largely remains unknown as well. It is, therefore, recommended that active and increased monitoring (and management where necessary and appropriate) of these species' nesting sites be continued for subsequent breeding seasons by Nature Parks staff, volunteers and interns.

- Though fairy terns did not breed on Phillip Island (Millowl) in 2021/22, ongoing monitoring of the 2019/20 breeding site is recommended. Additionally, any breeding sites should be placed on the MyBeachBird portal and habitat sites managed in the future. In the event that the birds return, signage and covert monitoring should be implemented.
- Continue pest plant and animal management at key breeding and roosting sites i.e. marram grass management and cat trapping at Observation Point.

Acknowledgements

The authors would firstly like to acknowledge and thank Phillip Island Nature Parks volunteers for their dedication which contributed to the successful outcomes of the 2021/22 breeding season on Phillip Island (Millowl). The authors would also like to acknowledge and thank: Alan Cheung for conducting the nest camera trap study for this season as an intern for the Nature Parks and for assisting with all facets of the hooded plover monitoring program; David Martin (Bass Coast Shire Council) for his help in managing the hooded plovers nesting activities on Bass Coast Shire beaches; the Beach Nesting Bird team at BirdLife Australia for their support and for access to the MyBeachBird portal; and, lastly, Phillip Island Nature Parks staff for their contributions towards logistics, banding, research, marketing and communications, and quarterly hooded plover counts as well as the Nature Park Board of Management for their continuing support of threatened species conservation on Phillip Island (Millowl).



Figure 7: Hooded plovers and chick as captured from the camera trap at Woolshed Bight.

Further reading

Throughout this report hooded plovers are the focus because the species is listed as *Vulnerable* both nationally (under the *Environment Protection and Biodiversity Conservation Act 1999*) and in Victoria (under the *Advisory List of Threatened Vertebrate Fauna in Victoria 2013*). Since active management of the hooded plover population on Phillip Island (Millowl) began in 1998, embodied as the 'Hooded Plover Watch Program', the population has increased from around 20 individuals to around 46 (± 2) individuals, or around 20 breeding pairs. In Figure 4, after the 1992-97 period (where active management began in 1998), it is apparent that the initial management efforts realised an increase in all of the breeding metrics (no. of eggs, no. of nests, no. of chicks, no. of fledged; no. of breeding pairs was not recorded until the 2002/03 season). From 1997 to 2012 the number of eggs, nests and chicks steadily increased, however, the number of fledglings remained fairly stable (5.8–7.6) across that 15-year period indicating a shortfall in the management strategies being used (Figure 1). From 2012 to 2017 targeted management strategies (e.g. volunteer nest monitoring, improved nest refuge design and signage, compliance operations, closure of informal tracks, eradication of foxes, control of cats, provision of beach shelters for chicks and management of coastal weeds) resulted in higher nesting success, i.e. less eggs and nests produced more chicks and fledglings (Figure 4) – a greater rate of breeding success. This latter trend is heading towards what would be an ideal breeding season for hooded plovers on the Island: a high proportion of eggs laid surviving to successfully fledge.

Maguire et al. (2013) note that there has been no Population Viability Analysis (PVA) conducted for hooded plovers in the past. Although nothing formal has been published, we can calculate simple metrics that give an indication of the viability of the Island's hooded plover population. Fledglings per breeding pair is the key metric used to determine breeding success for a given breeding season (Maguire et al. 2013).

For the past 10 years (2012 – 2022) the total number of hooded plovers on Phillip Island (Millowl) has been relatively stable at 43 (± 2), suggesting that a carrying capacity has been reached for the amount of suitable habitat that is available. We can suggest, then, that providing the number of fledglings per pair is sufficient in maintaining 43 breeding individuals, the population may be regarded as stable. This may change as more or less suitable habitat becomes available through time. To calculate the number of hooded plover fledglings required to maintain a stable island population, we need to determine how long one generation length is for the species. Maguire et al. (2013) define a generation length as “the average age of parents of a current cohort and reflects the turnover rate of breeding individuals in a population [which] is greater than the age at first breeding and less than the age of the oldest breeding individual.” The equation used to calculate this value is simply $(\text{longevity} + \text{age at maturity}) \div 2 = \text{generation length}$.

On Phillip Island (Millowl) the oldest known individual was Orange (left) LT, who lived 22.5 years (1998 – 2020). Baird and Dann (2003) previously calculated the sexual maturity of hooded plovers to be 1.7 years. Therefore, a generation length for hooded plovers is 12.1 years. Previously, Maguire et al. (2013) calculated a generation length for hooded plovers as 9.85 years based on the then oldest known individual (18 years). Hooded plover fledglings have a survival rate of 55% (Weston 2000) and through the course of a generation length (12.1 years) it would require 6.61 hooded plover chicks to fledge each breeding season to maintain a stable population of 43 individuals (assuming 55% don't survive, i.e., 3.64 fledglings per year survive \times 12.1 years) on Phillip Island (Millowl). Over the past 10 years, the mean number of breeding pairs per season has been 18.7, so the fledglings per breeding pair value required to sustain this number of hooded plovers on Phillip Island (Millowl) is 0.356. Previously, a target fledglings per breeding pair rate of 0.47 was regarded as the ideal benchmark by Birdlife Australia. However, these calculations assume no movement of fledged young in or out of Phillip Island's population, which we know is not the case.

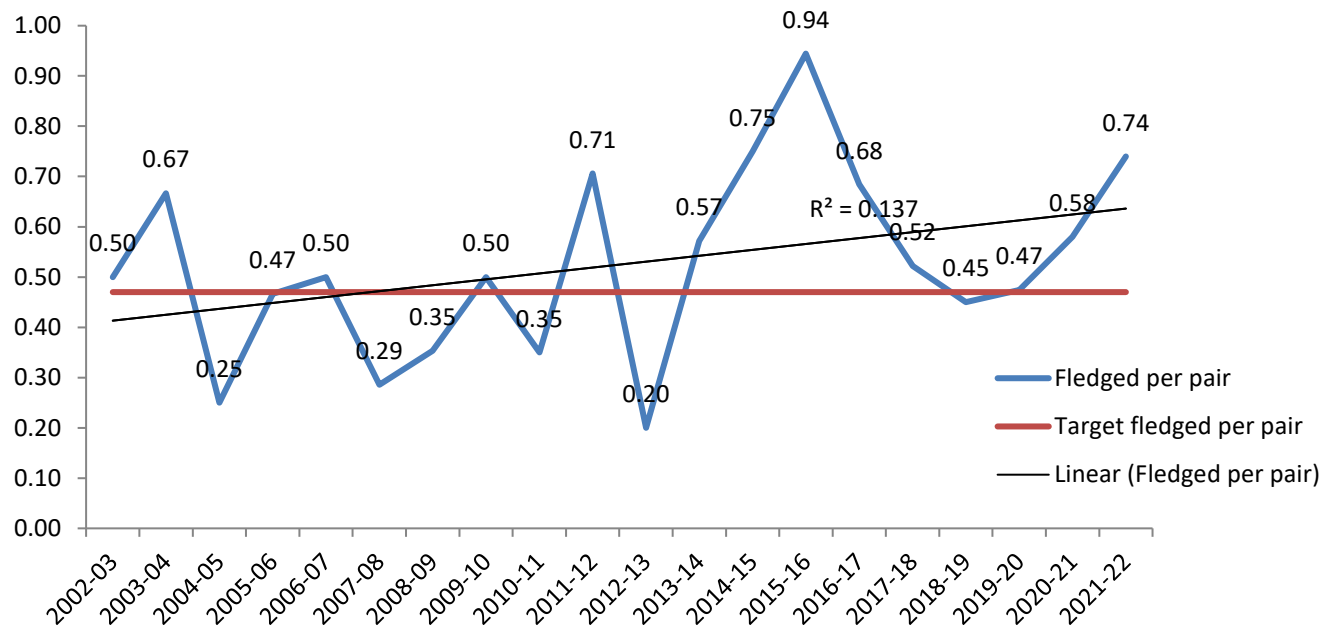


Figure 8: The fledged per pair for each breeding season since 2002/03 when breeding pairs started being recorded with a linear trendline against the target fledged per pair rate of 0.47 suggested by Birdlife Australia.

During the most successful breeding period to date (2012-17) the average fledged per pair value was 0.63, nearly double the required 0.36 threshold. Although there was a 3-year downfall in the fledged per pair rate after the successful 2015/16 breeding season, the overall trend shows it is increasing (Figure 8). It is suspected that an increase in hooded plover predation by cats and predatory birds, namely ravens (*Corvus* sp.), Australian magpies (*Cracticus tibicen*), Pacific gulls (*Larus pacificus*), Kelp gulls (*Larus dominicanus*) and various raptors, drove this recent downturn in breeding efficiency.

In addition, disturbance by dogs has caused known chick deaths in recent times. Greater monitoring effort is required to definitively determine causes of nest/chick failures.

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Appendices

Appendix A: Hooded plover nesting site summary table 2021/22

Nest	Location	Find Date	Adult Bands	Eggs	Chicks	Fledge Date	Fledged	Chick Bands	Last seen Date	Failure events
1	Magiclands	05/09/2021	YLF '66' UB	2				failed	7/09/2021	Suspect magpie/raven
2	Woolamai SLSC	13/09/2021	WLF 'RL' WLF 'JL'	3				failed	27/09/2021	Unknown
3	Anzacs	13/09/2021	OLF 'CH' UB	1				failed	21/09/2021	Unknown
4	Anchorage Rd	07/10/2021	OLF 'EZ' WLF 'EL'	3	3			failed	18/11/2021	Unknown
5	Ventnor - Devon Ave	12/10/2021	YLF '23' UB	2	1			failed	21/11/2021	Egg- suspect bad weather/high tides Chick – unknown
6	Woolamai SLSC	06/11/2021	WLF 'RL' WLF 'JL'	3	2	4/01/2022	2	UB UB		Unknown abandoned
7	Flynns Reef	23/11/2021	YLF '12' UB	2	2	17/01/2022	1	UB		Unknown
8	Silverleaves east	24/11/2021	UB UB	2				failed	29/11/2021	Unknown
9	Anchorage Rd	26/11/2021	OLF 'EZ' WLF 'EL'	3	3	5/02/2022	1	YLF '93'		Unknown
10	Smiths Beach far east	29/11/2021	UB UB	3	3	09/02/2022	3	YLF '95' YLF '96' YLF '97'		
11	Ventnor - Devon Ave	06/12/2021	YLF '23' UB	3	3	09/02/2022	3	YLF '98' YLF '99' YLF '1A'		
12	Kitty Miller Bay	06/12/2021	YLF '21' UB	3				failed	21/12/2021	Unknown
13	Colonnades	17/12/2021	YLF '03' UB	2				failed	31/12/2021	Unknown

14	Farm Beach	20/12/2021	YLF '82' UB	1				failed	20/12/2022	Unknown
15	Silverleaves east	24/12/2021	UB UB	1				failed	31/12/2021	Unknown
16	Summerlands Beach centre	24/12/2021	YLF '39' UB	3				failed	4/01/2022	Unknown
17	Kitty Miller Bay	30/12/2021	YLF '21' UB	3	1	7/03/2022	1	YLF "1B"		Suspect magpie/raven
18	Colonnades west	07/01/2022	YLF '31' YLF '49'	2				failed	6/02/2022	Unknown
19	Colonnades	07/01/2022	YLF '03' UB	2				failed	13/01/2022	Unknown
20	Anzacs west	07/01/2022	Gm/(YR) UB	1				failed	14/01/2022	Unknown
21	Berrys Beach centre	13/01/2022	OLF 'CD' OLF 'DM'	3				failed	29/01/2022	Suspect magpie/raven
22	Anzacs west	20/01/2022	Gm/(YR) UB	3				failed	10/02/2022	Suspect magpie/raven
23	Colonnades	20/01/2022	YLF '03' UB	2	1			YLF '2A'	24/03/2022	Eggs – unknown abandoned Chick – suspect bad weather/high tides
24	Cowries east	21/01/2022	OLF 'YU' YLF '78'	2				failed	6/02/2022	Unknown
25	Crazy Birds east	24/01/2022	YLF '19' YLF '86'	3	1			failed	15/03/2022	Egg 1 – suspect addled Egg 2 – unknown Chick – unknown
26	Woolshed Bight	01/02/2022	YLF '33' UB	3	3	1/04/2022 (3A, 5A) 11/04/2022 (4A)	3	YLF '3A' YLF '4A' YLF '5A'		
27	Forrest Caves centre	04/02/2022	OLF 'BR' UB	2				failed	14/02/2022	Suspect magpie/raven
28	Anzacs west	24/02/2022	Gm/(YR) UB	3				failed	04/02/2022	Suspect magpie/raven

29	Colonnades west	24/02/2022	YLF '31' YLF '49'	3	2			failed	16/04/2022	Chick 1– unknown Chick 2 – suspect bad weather/high tides (Body found among seaweed high on beach)
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Appendix B: Nesting site summary table for pied oystercatchers, sooty oystercatchers and red-capped plovers 2021/22

Species	Nest	Location	Find Date	Adult Bands	Clutch No.	Eggs	Chicks	Fledged	Notes
POC	1	Observation Point	02/10/2021	?	1	2			
POC	2	Observation Point	02/10/2021	?	1	2			
POC	3	Observation Point	02/10/2021	RLF 2L RLF 5R	1	1			
SOC	1	Dolphin Drive	25/10/2021	UB	1	1			
RCP	1	Dolphin Drive	06/12/2021	UB	1	2	2	Unconfirmed 2	Fledglings seen at location but cannot confirm they are the same ones

Appendix C: Band details of birds sighted on Phillip Island as recorded in the quarterly hooded plover count and MyBeachBird portal in the 2021/22 season

Date banded	Band number	Location seen	Colour combination	Location banded	Age at banding	Sex	Partner details
13/02/2013	05248057	Colonnades	03 Left (Yellow)	Silverleaves (PI)	Juvenile	Unknown	Un-banded partner
05/01/2015	05268605	Flynn's Beach	12 Left (Yellow)	Anchorage Rd (PI)	Juvenile	Female	Un-banded partner
29/07/2015	05268612	Crazy Birds	19 Left (Yellow)	Surf Beach (PI)	Adult	Male	Partner of 86 Left (Yellow)
29/10/2015	05268613	Kitty Miller Bay, Summerlands	21 Left (Yellow)	Elizabeth Cove (PI)	Juvenile	Male	Un-banded partner
23/11/2015	05268615	Devon Ave, Woolshed Bight, Farm Beach	23 Left (Yellow)	Red Rocks (PI)	Juvenile	Male	Un-banded partner
23/01/2017	05268623	Colonnades	31 Left (Yellow)	Surf Beach (PI)	Juvenile	Male	Partner of 49 Left (Yellow)
31/01/2017	05268624	Elizabeth Cove	32 Left (Yellow)	BellaVista Rd (PI)	Juvenile	Female	
31/01/2017	05268625	Woolshed Bight	33 Left (Yellow)	Belavista Rd (PI)	Juvenile	Female	Un-banded partner
17/02/2017	05268628	Forrest Caves	36 left (Yellow)	Hutchison Beach (PI)	Juvenile	Female	Non-breeding
24/02/2017	05268631	Summerlands	39 Left (Yellow)	Elizabeth Cove (PI)	Juvenile	Male	Un-banded partner
24/01/2018	05268641	Forrest Caves, Colonnades	49 Left (Yellow)	Woolshed Bight (PI)	Juvenile	Female	Partner of 31 Left (Yellow)
22/02/2019	05268658	Magiclands	66 Left (Yellow)	Surf Beach (PI)	Juvenile	Male	Un-banded partner
11/02/2020	05268660	Summerlands	68 Left (Yellow)	Graydens Rd (PI)	Juvenile	Male	Non-breeding
27/10/2020	05268670	Shelly Beach, Cowrie Beach	78 Left (Yellow)	Anchorage Rd (PI)	Juvenile	Female	Partner of YU Right (Orange)
27/10/2020	055268672	Summerlands	80 Left (Yellow)	Anchorage Rd (PI)	Juvenile	Female	Non-breeding
13/11/2020	05268673	Forrest Caves	81 Left (Yellow)	Crazy Birds (PI)	Juvenile	Female	Non-breeding
13/11/2020	05268674	Devon Ave, Woolshed Bight, Farm Beach	82 Left (Yellow)	Crazy Birds (PI)	Juvenile	Female	Un-banded partner
08/12/2020	05268674	Anzacs	83 Left (Yellow)	Devon Ave (PI)	Juvenile	Female	Non-breeding

08/12/2020	05268676	Berrys, Summerlands, Flynn's, Shelly Beach	84 Left (Yellow)	Devon Ave (PI)	Juvenile	Male	Non-breeding
14/01/2021	05268678	Crazy Birds	86 Left (Yellow)	Crazy Birds (PI)	Adult	Female	Partner of 19 Left (Yellow)
06/04/2021	05268684	KMB	92 Left (Yellow)	Kitty Miller Bay (PI)	Juvenile	Male	Non-breeding
04/04/2014	05306135	Forrest Caves	BR Right (Orange)	Boags Rocks	Juvenile	Male	Un-banded partner. Nest 27 failed
19/04/2021	05288099	Summerlands	CA Right (White)	Collendina	Juvenile	Unknown	Need to check record as entangled and euthanized 5/4/22
28/03/2012	05245420	Berrys Beach	CD Right (Orange)	Walkerville North	Juvenile	Female	Partner of DM Left (Orange)
14/10/2011	05248079	Anzacs	CH Left (Orange)	Woolamai SLSC (PI)	Adult	Unknown	Un-banded partner
05/03/2021	05287973	Smiths Beach	CL Right (White)	Balnarring Beach	Juvenile	Unknown	Non-breeding
18/02/2011	05248036	Anzac west	Gm/YR (Gm/_ _)	Crazy Birds (PI)	Juvenile	Unknown	Un-banded partner
20/03/2017	05280592	Surfies Point	CU Right (White)	Cape Patterson	Juvenile	Male	Non-breeding
15/01/2015	05280561	Berrys Beach	DM Left (Orange)	Desal Beach	Juvenile	Male	Partner of CD Right (Orange)
05/03/2020	05287991	Anchorage Rd	EL Right (White)	Rye Big Rock	Juvenile	Unknown	Partner of EZ Left (Orange).
29/12/2012	05268883	Anchorage Rd	EZ Left (Orange)	Pea Creek Estuary	Juvenile	Unknown	Partner of EL Right (White)
13/02/2019	05287997	Woolamai SLSC west	JL Right (White)	Gunnamatta Fingal Track	Juvenile	Female	Partner of RL Left (White).
12/02/2020	05306194	Forrest Caves, Woolamai	KB Left (White)	Williamsons Beach west	Juvenile	Unknown	Non-breeding
26/07/2010	05245490	Justice Road, Forrest Caves	PX Right (Orange)	Forrest Caves (PI)	Sub Adult	Unknown	Non-breeding
07/02/2018	05306191	Woolamai SLSC west	RL Left (White)	Twin Reefs	Juvenile	Male	Partner of JL Right (White)
28/12/2015	05280576	Woolamai	VV Left (Orange)	Bore Beach	Adult	Unknown	Non-Breeding
8/01/2016	05280577	Shelly Beach, Cowrie Beach	YU Right (Orange)	Sandy Waterhole	Juvenile	Male	Partner of 78 Left (Yellow)

Appendix D: Summary statistics for this hooded plover breeding season (2021/22), and mean values for the 1992-97 to 2017-22 periods

Variable	2021/22	2017-22 average	2012-17 average	2007-12 average	2002-07 average	1997-02 average	1992-97 average
No. breeding pairs	19	20	17.2	17.2	14.8	--	--
No. nests	29	40.4	31.6	42.4	32.8	17.4	14.8
No. eggs	70	94.6	72.8	98.2	74.8	41.4	37.2
No. chicks	25	31.8	29.2	21.6	17.6	12.4	7.4
No. fledglings	14	11	10.8	7.6	7	5.8	2.6
Av. nests per pair	1.53	2.02	1.84	2.45	2.21	--	--
Eggs to chicks survivorship	35.71%	33.62%	40.11%	22%	24%	30%	20%
Chicks to fledge survivorship	56%	34.59%	36.99%	35%	40%	47%	35%
Eggs to fledge survivorship	20%	11.63%	14.84%	8%	9%	14%	7%
Eggs per clutch	2.41	2.34	2.3	2.3	2.3	2.4	2.5
Fledged per clutch	0.48	0.27	0.34	0.18	0.21	0.33	0.18
Fledged per pair	0.74	0.55	0.63	0.44	0.47	--	--