PHILLIP ISLAND (*MILLOWL*) NESTING SHOREBIRD BREEDING SEASON 2020-2021 END OF SEASON REPORT

Phillip Island NATURE PARKS

We acknowledge the Traditional Custodians of the land on which we live, work and learn, the Bunurong people. We pay our respects to their Elders past and present.

Summary

Eighteen pairs of Hooded plover (*Thinornis cucullatus cucullatus*) bred in the 2020/2021 breeding season on Phillip Island (*Millowl*), which is consistent with trends of the previous 2019/20 season and the 2013/14 – 2017/18 5 year period (a period of good breeding success). The 18 breeding pairs cumulatively laid 101 eggs across a total of 46 nests ($\bar{x}$ = 2.196 eggs per nest), these variables being higher than for the 2013/14 – 2017/18 period. From the 101 eggs and 46 nests, 28 chicks hatched from 14 nests – a lower yield compared to the 2013/14 – 2017/18 period – and of the 28 chicks, 11 survived to fledge successfully from 7 nests, which is a slightly higher rate than the 2013/14 – 2017/18 period. The fledged per pair rate for Hooded plovers this season was 0.61 which is higher than last season (0.47), but lower than the 2013/14 – 2017/18 period ($\bar{x}$ = 0.68). Additionally, a small-scale camera trapping pilot study was undertaken to capture causes of nest failure during the 2020/21 breeding season. Three nests were selected for monitoring during the project and no nest failures were recorded, however, potential predators were recorded foraging near some of the nests. For a detailed summary, see Table 1. At least 4 pairs of Pied oystercatchers (*Haematopus longirostris*), 4 pairs of Sooty oystercatchers (*Haematopus fuliginosus*) and one Red-capped plover (*Charadrius ruficapillus*) breeding colony of 3 breeding pairs consisting of at least 10 individuals were also recorded in the 2020/21 breeding season. One Pied oystercatcher chick was confirmed to fledge successfully, however, no fledglings were confirmed for Sooty oystercatchers or Red-capped plovers, which may have been due to a lack of monitoring effort. See Appendix C for a detailed summary. No breeding was recorded for Fairy terns (*Sternula nereis*) on Phillip Island (*Millowl*) in 2020/21.

Table 1: Summary statistics for this Hooded plover breeding season (2020/21), the previous season (2019/20), and mean values for the 2013/14 – 2017/18 period.

Variable	2020/21	2019/20	2013/14 – 2017/18
First nest	31/08/2020	26/09/2019	18-Sep
Last nest	12/02/2021	21/02/2020	23-Feb
No. nests	46	41	32.6
No. eggs	101	90	78
No. chicks	28	24	34.4
No. fledglings	11	9	12.4
No. breeding pairs	18	19	18.2
Av. eggs per nest	2.196	2.195	2.393
Av. nests per pair	2.556	2.158	4.286
No. nests hatched	14	11	14.454
Eggs to chicks survivorship	27.72%	26.67%	44.10%
Chicks to fledge survivorship	39.29%	37.50%	36.05%
Eggs to fledge survivorship	10.89%	10.00%	15.90%
Eggs per clutch	2.196	2.195	2.393
Fledged per clutch	0.239	0.220	0.380
Fledged per pair	0.611	0.474	0.681

Volunteer Activities

Despite the numerous obstacles encountered throughout 2020/21, the results achieved for this breeding season would not have been possible without the dedication of Phillip Island Nature Parks' volunteers. Their efforts helped contribute towards the above average Hooded plover chick to fledgling survivorship (39.29%), which yielded 11 new fledglings for the Island (Table 1). During the 2020/21 season, there was a total of 287.56 volunteer hours (Table 2). This was a significant reduction from previous years due to the COVID-19 pandemic and resulting suspension of volunteer activities across the Nature Parks.

Table 2: Summary of Hooded plover related volunteering activity hours for the 2019/20 breeding season.

Activity	2020/21	2019/20	2018/19	2017/18
Monitoring	75.81	422.76	--	--
Guardian	--	250.92	--	--
Counts	6.5	49.50	--	--
Community Engagement Events	--	25.5	--	--
Internship*	205.25	261.50	--	
Deployment*	382.5	--	--	--
Total	**287.56**	**748.68**	**454.55**	**407**

* not included in total volunteer hours

Internships

During the 2019/20 breeding season an internship program was implemented to begin assessing the behaviour and motivations of beach users on Phillip Island (*Millowl*) and provide general on the ground support to the Hooded plover team. This behavioural social science study first looked at compliance across three beaches under different management strategies. The study was due to continue over the 2020/21 breeding season with a Belief Elicitation Survey of beach users to be carried out by an intern. Due to social distancing requirements of the COVID-19 pandemic, this social research internship was modified to be a camera trapping study, aiming to better establish causes of nest failure for Hooded plovers on Phillip Island (*Millowl*), while still assisting with monitoring and management activities. Cameras were deployed at three nest sites; Flynns Beach – centre, Anchorage Rd., and Kitty Miller Bay. No instances of predation or nest destruction were recorded on the cameras.

Redeployed Staff

As outlined above, volunteer hours in the 2020/21 breeding season were significantly reduced due to the COVID-19 pandemic. With reduced workloads in the tourism sector of the Nature Parks, some staff were redeployed to different conservation activities. Some staff were redeployed to assist with Hooded plover monitoring and management across Phillip Island (*Millowl*). These staff undertook 382.5 hours, helping to fill the void left by volunteering being on hold.

BACKGROUND

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 44 (± 2) individuals, or around 20 breeding pairs. In Figure 1, after the 1993-98 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 2003/04 season). From 1998 to 2013 the number of eggs, nests and chicks steadily increased, however, the number of fledglings remained fairly stable (6.6 – 7.6) across that 15 year period indicating a shortfall in the management strategies being used (Figure 1). From 2013 to 2018 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 1) – 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.

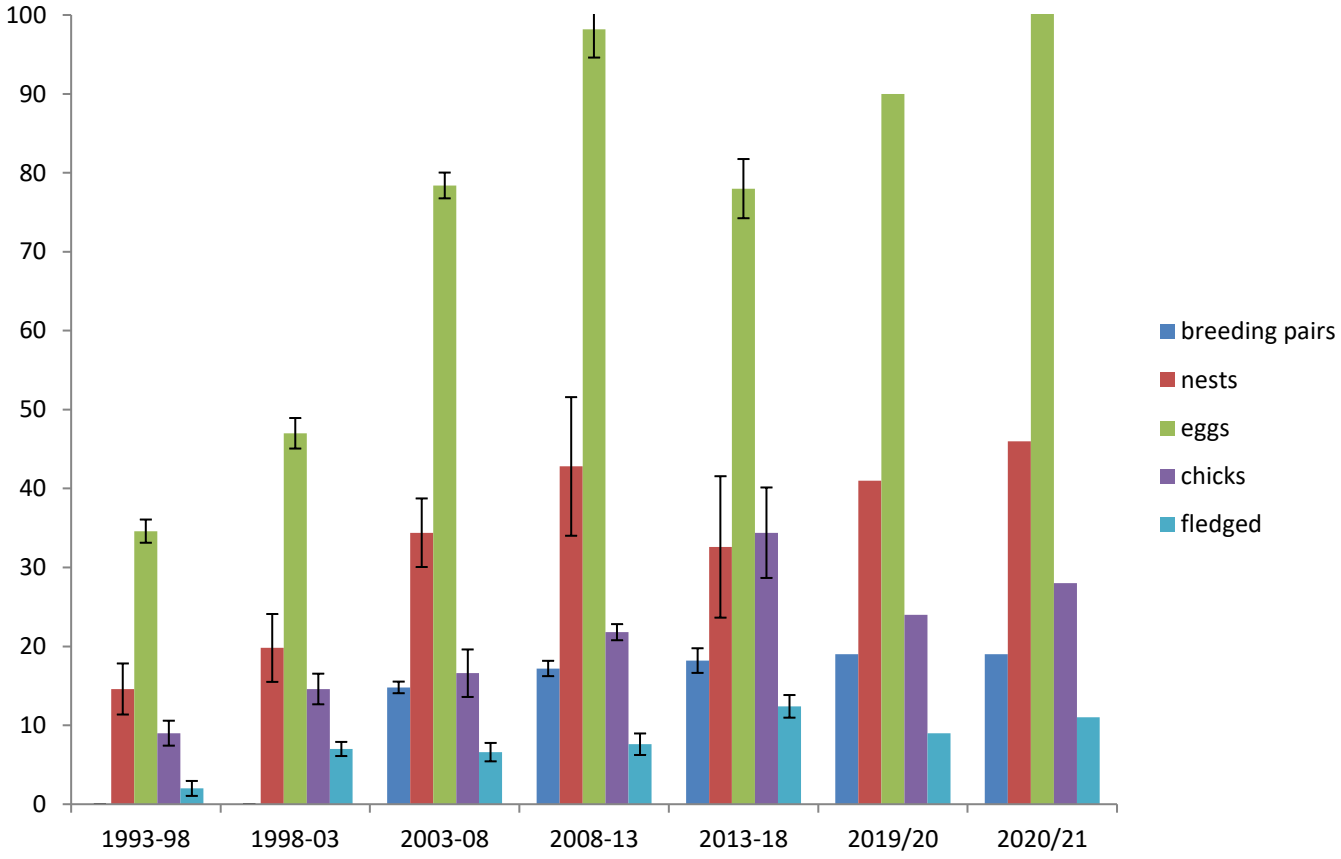

Figure 1: Five year breeding season averages (±SE) for breeding metrics of Hooded plovers on Phillip Island (*Millowl*) 1993 – 2018, and the most recent 2019/20 and 2020/21 seasons breeding metrics data.

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 (2010 – 2020) the total number of Hooded plovers on Phillip Island (*Millowl*) has been relatively stable at 44 (± 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 44 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 (longevity + age at maturity) ÷ 2 = 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 44 individuals (assuming 55% don't survive, i.e., 3.64 fledglings per year survive × 12.1 years) on Phillip Island (*Millowl*). Over the past 10 years, the mean number of breeding pairs per season has been 18.6, so the fledglings per breeding pair value required to sustain this number of Hooded plovers on Phillip Island (*Millowl*) is 0.356. However, the Island's Hooded plover population is subject to fluctuations. The highest number of breeding pairs recorded on the Island was 23 during the 2017/18 season. There were a total of 52 individuals on the Island at that time, and if a stable population of 52 individuals was desired, this would require a fledglings per breeding pair rate of 0.42. 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 the Island's population.

During the most optimal breeding period to date (2013/14 – 2017/18) the average fledged per pair value was 0.68, nearly double the required 0.36 threshold. Fledged per pair values of 0.47 and 0.61 were recorded for the most recent breeding seasons of 2019/20 and 2020/21, respectively. 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, is driving this recent downturn in breeding efficiency. In addition, disturbance by dogs has caused known chick deaths in recent times including this breeding season. Greater monitoring effort is required to definitively determine causes of nest/chick failures.

HOODED PLOVER BREEDING SEASON 2020/21

Nesting Outcomes

During the 2020/21 season, 18 breeding pairs made 46 nests with a total of 101 eggs laid in these nests between 31/08/2020 and 12/02/2021 (Table 1). Nests with eggs were distributed across 26 nesting sites on the Island, with 14 of those sites producing chicks, and 7 of those sites successfully producing fledglings (Figure 2).

Figure 2: Summary map of Hooded plover nesting sites (n=26) distributed on Phillip Island (Millowl) and the breeding outcome at each site (eggs, chicks, or fledged).

The number of nests, eggs and breeding pairs were not significantly different from predicted means (Figure 3) and data were normally distributed (Appendix B). Additionally, a pilot study was conducted to assess the efficacy of camera trapping at capturing any events of nest failure during the 2020/21 breeding season and to assist with reactive management strategies. Three nests were selected for monitoring and no nest failures were recorded; however, potential predators were recorded foraging near the nests. The pilot study highlighted the potential efficacy of camera trapping in supporting reactive management strategies. Egg floating was also employed throughout the 2020/21 breeding season to determine the age of clutches that were found after the fact.

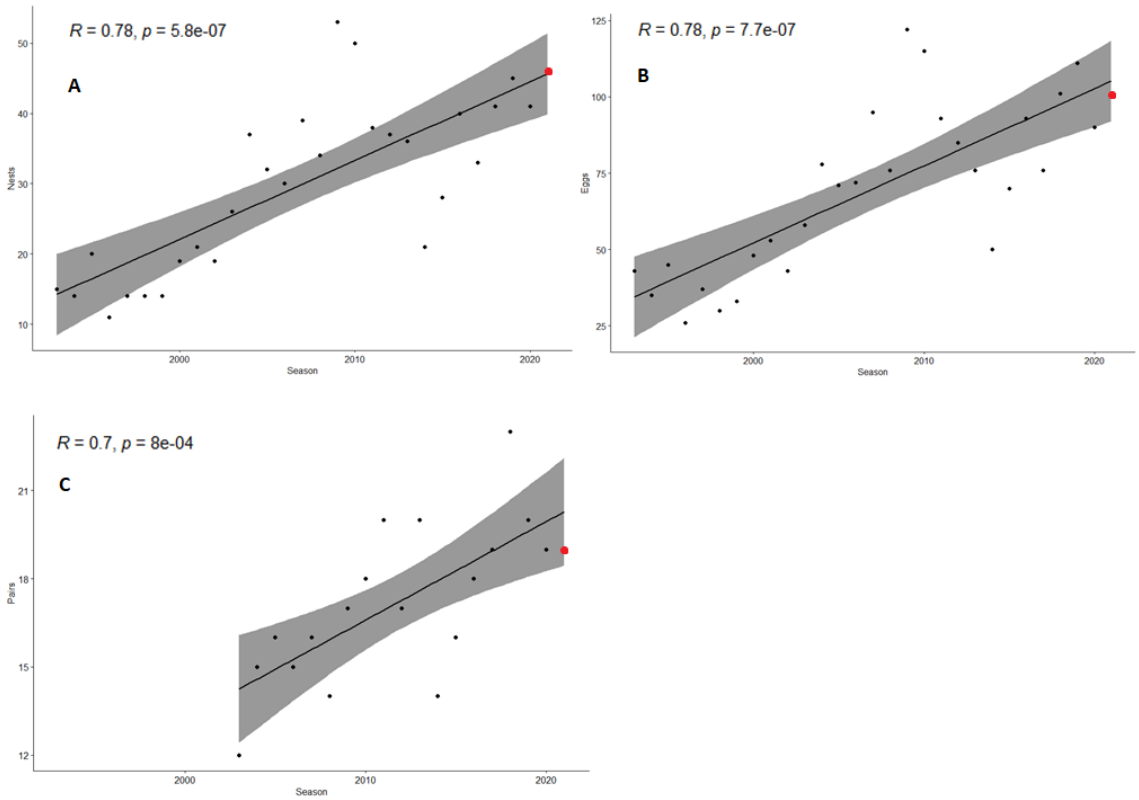

Figure 3: Correlation plots with test statistics, regression lines and 95% confidence intervals (dark grey area) for A) no. of nests, B) no. of eggs, and C) no. of breeding pairs (from 2003/04 onwards) for Hooded plovers on Phillip Island (*Millowl*). Red dots indicate results for the 2020/21 breeding season.

With respect to nesting effort, the season was divided into three periods: pre-Christmas, Christmas, and post-Christmas. The pre-Christmas period (31/08/2020 – 18/12/2020; 110 days) was characterised by the highest number of nesting attempts (n = 31; 0.28 nests/day) and the highest number of nest failures (n = 27) (Figure 5).

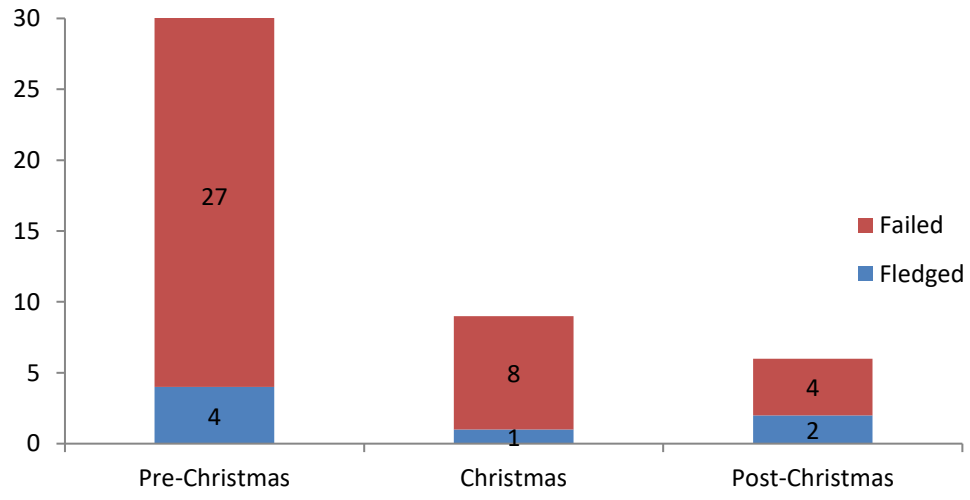

Figure 5: Hooded plover nesting attempts resulting in failure or success (fledged) for each period of the 2020/21 breeding season.

The Christmas period (19/12/2020 – 26/01/2021; 39 days) was characterised by a slight reduction in nesting attempts (n = 9; 0.23 nests/day). An increase in human-Hooded plover nesting site interactions may have resulted in this reduction. The post-Christmas period (27/01/2020 – 12/02/2020; 17 days) was characterised by the highest rate of nesting attempts (n = 6; 0.35 nests/day), but appeared to end abruptly, presumably as a result of a sudden onset of cold weather triggered by the end of a La Niña weather pattern.

The main causes of nest failures across all three periods (Figure 7) were mostly due to unknown causes (n = 15), as well as suspect severe weather/tidal events (n = 6), suspect raven/magpie predation (n = 5), suspect human disturbance (n = 5), and suspect cat predation (n = 1). Suspected events were based on any remaining evidence found at the nesting site post nest failure. See Appendix A for the nesting site summary.

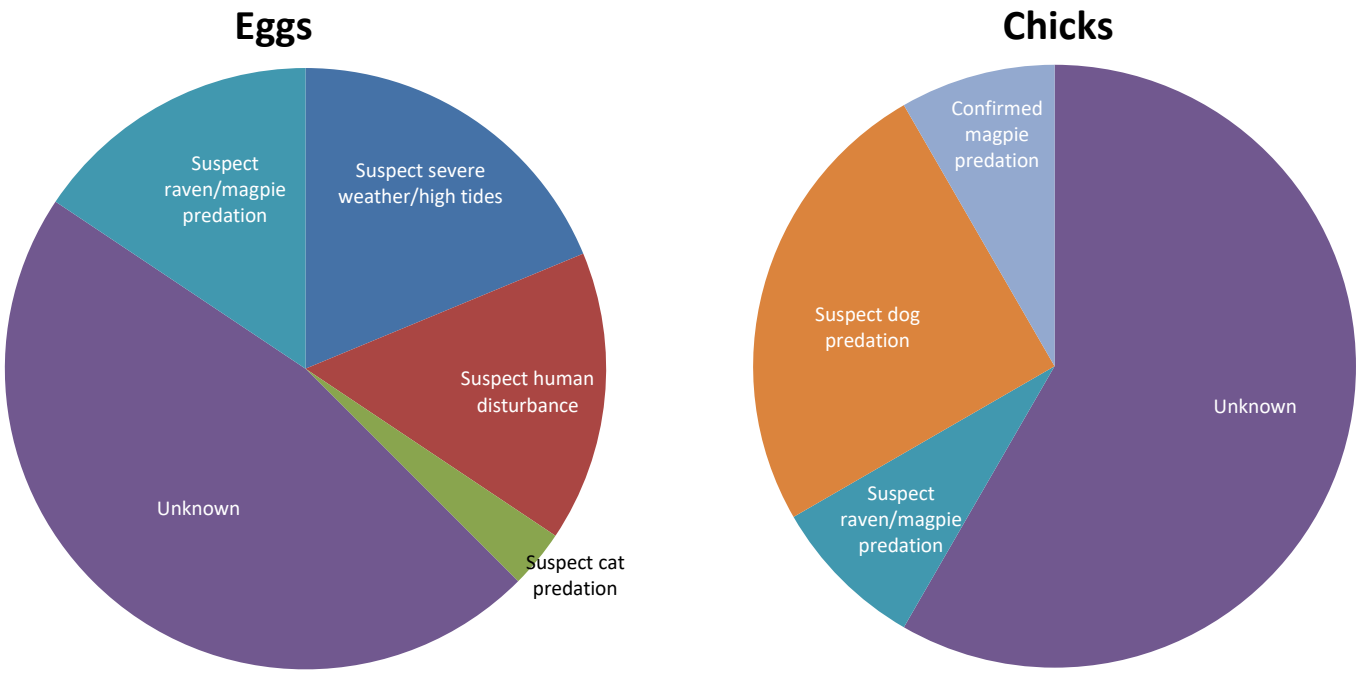

Figure 7: Causes of Hooded plover nest (with eggs) failure and chick failure during the 2020/21 breeding season.

Fledging Outcomes

During the 2020/21 breeding season 28 chicks hatched from 14 nesting sites and 11 fledglings from 7 of those nesting sites (Figure 2). The number of chicks produced during the 2020/21 season were significantly less than the predicted mean (Figure 8) and data were not normally distributed (Appendix B), so a Kendall rank correlation test was used to evaluate the test statistics. The number of fledglings produced were not significantly different from predicted means (Figure 8) and data were normally distributed (Appendix B). For the 2020/21 season egg to chick survivorship was 27.72%, slightly higher than the 2019/20 season (26.67%) but lower than the average 44.10% for the 2013/13 – 2017/18 period (Table 1). This trend in lower egg to chick survivorship indicates area for improvement regarding the management strategies currently being used to allow eggs to hatch successfully. It is worth noting, however, that chick to fledgling survivorship for the 2020/21 season was 39.29% as opposed to 36.05% for the 2013/13 – 2017/18 period (Table 1). This result indicates the validity of the management efforts employed during the 2020/21 season to allow chicks to successfully fledge.

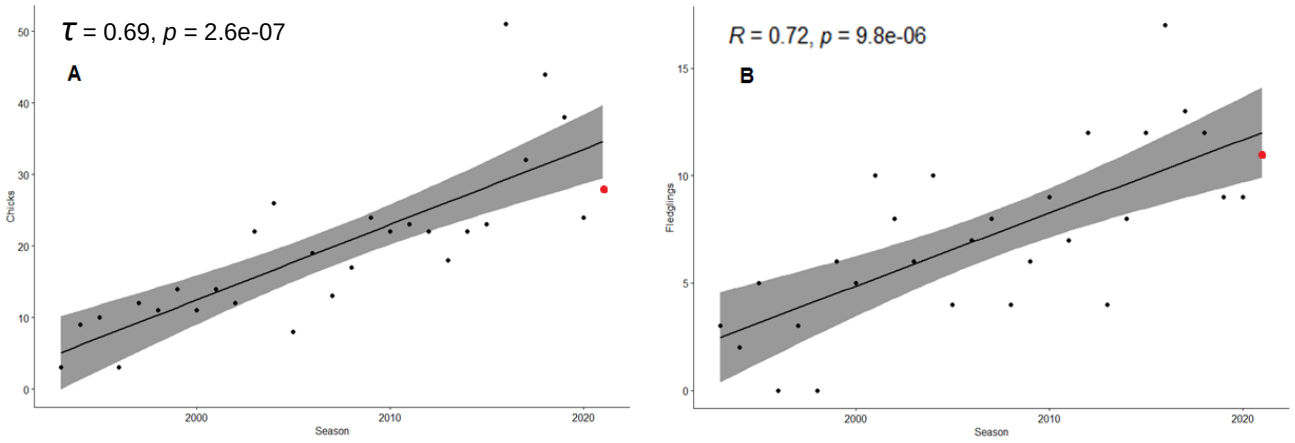

Figure 8: Kendall rank correlation test (A) and Pearson correlation test (B) plots with test statistics, regression lines and 95% confidence intervals (dark grey area) for A) no. of chicks, and B) no. of fledglings for Hooded plovers on Phillip Island (*Millowl*). Red dots indicate results for the 2020/21 breeding season.

With regards to the fledging efforts, 8 fledglings were produced from 4 nesting sites during the pre-Christmas period, 1 fledgling was produced from 1 nesting sites during the Christmas period, and 2 fledglings were produced from 2 nesting sites during the post-Christmas period. Throughout the pre-Christmas period, Government imposed social restrictions for the COVID-19 pandemic dramatically reduced human-Hooded plover interactions, which probably leant to the success for this period. The lower success rates during 2020/21 post-Christmas period as compared to the 2019/20 season are thought to be related to the increased human-Hooded plover interactions resulting from an easing of Government imposed social restrictions and an increased desire for people to use beach areas after previously being in lockdown. The most common causes of chick failure across all 3 periods (Figure 7) were unknown (n = 7), suspect dog predation (n = 3), suspect raven/magpie predation (n = 1) and a confirmed magpie predation event (n = 1). Suspected events were based on any remaining evidence found at the nesting site post chick failure. See Appendix A for the chick and fledgling site summary. The 11 chicks successfully fledge from 18 breeding pairs rendered a fledged per pair rate of 0.611 for Phillip Island (*Millowl*).

Banding and Flagging

Throughout the 2020/21 breeding season, a total of 14 chicks and 1 adult were caught, biometrically measured, banded, given a unique leg flag and had feather samples taken for sexing. The adult was captured in order to remove a piece of dried seagrass (*Amphibolis antarctica*) stem that had become stuck in the skin of the bird's flank. This bird was taken to a local veterinary practice and the stem was removed under anaesthetic. Unfortunately, due to suspect dog predation, 3 of the chicks did not survive successfully fledge. See Table 3 below for a summary of their details.

The relatively high success rates of Phillip Island (*Millowl*) outlined above position the region as a fledgling source for the rest of Victoria. This is confirmed by the presence of Phillip Island (*Millowl*) leg flags appearing in other regions.

PIED OYSTERCATCHER BREEDING SEASON 2020/21

Limited data were collected for Pied oystercatchers on Phillip Island (*Millowl*) for the 2020/21 breeding season. At least 4 pairs were recorded nesting across Observation Point (n = 3) and Kitty Miller Bay (n = 1). At least 9 eggs were laid across 5 nests. It is uncertain how many chicks in total were produced, but 2 were confirmed via camera traps at Observation Point. One of these chicks survived to successfully fledge, however, no banding or flagging was conducted. See Appendix C for a detailed summary.

SOOTY OYSTERCATCHER BREEDING SEASON 2020/21

Limited data were collected for Sooty oystercatchers on Phillip Island (*Millowl*) for the 2020/21 breeding season. At least 4 pairs were recorded nesting across Summerlands Beach east (n = 1), Shelley Beach (n = 1) and Cowrie Beach (n = 2), where at least 9 eggs were laid across 5 nests. It is uncertain how many chicks in total were produced, but 2 were suspected to have hatched at Summerlands Beach east. No fledglings were sighted throughout the breeding season and no chicks were banded or flagged. See Appendix C for a detailed summary.

RED-CAPPED PLOVER BREEDING SEASON 2020/21

Limited data were collected for Red-capped plovers on Phillip Island (*Millowl*) for the 2020/21 breeding season. An active breeding colony was found at Observation point consisting of at least 3 breeding pairs and 10 individuals. Within the colony there were 3 nests with a total of 4 eggs. There was evidence of a recent high tide event that had inundated at least one of those nests, and subsequent monitoring found that all those nests eventually failed. No chicks or fledglings were sighted throughout the breeding season and no chicks were banded or flagged.

FAIRY TERN BREEDING SEASON 2020/21

Fairy Terns (*Sternula nereis*) successfully bred at Observation Point in 2019/20. Some individuals returned in October 2020, but no nesting activity was observed in this location. A colony of ~35 Fairy terns (presumably some of the same individuals that bred at Observation Point in 2019/20) were recorded nesting and breeding on nearby Rams Island. Throughout the 2020/21 breeding season, Observation Point experienced a higher level of tidal inundation due to topographical changes compared to the previous season thus limiting the ability for nesting shorebirds to successfully nest in the area.

Table 3: Summary of Hooded plover chick band and flag details of the 2020/21 season.

Date	Nesting site	Band no.	Band location	Leg flag details	Flag location	Bird status	Notes
27/10/2020	Anchorage Rd	05268670	Left tarsus	Yellow 78	Left tibia	Chick	
27/10/2020	Anchorage Rd	05268671	Left tarsus	Yellow 79	Left tibia	Chick	
27/10/2020	Anchorage Rd	05268672	Left tarsus	Yellow 80	Left tibia	Chick	
13/11/2020	Crazy Birds	05268673	Left tarsus	Yellow 81	Left tibia	Chick	
13/11/2020	Crazy Birds	05268674	Left tarsus	Yellow 82	Left tibia	Chick	
08/12/2020	Ventnor - Devon Ave	05268675	Left tarsus	Yellow 83	Left tibia	Chick	
08/12/2020	Ventnor - Devon Ave	05268676	Left tarsus	Yellow 84	Left tibia	Chick	
29/12/2020	Woolamai SLSC West	05268677	Left tarsus	Yellow 85	Left tibia	Chick	
14/01/2021	Crazy Birds	05268678	Left tarsus	Yellow 86	Left tibia	Adult	Captured bird for surgery and banded opportunistically
24/02/2021	Smiths Beach far east	05268679	Left tarsus	Yellow 87	Left tibia	Chick	
24/02/2021	Ventnor - Devon Ave	05268680	Left tarsus	Yellow 88	Left tibia	Chick	Did not successfully fledge
24/02/2021	Ventnor - Devon Ave	05268681	Left tarsus	Yellow 89	Left tibia	Chick	Did not successfully fledge
24/02/2021	Ventnor - Devon Ave	05268682	Left tarsus	Yellow 90	Left tibia	Chick	Did not successfully fledge
01/04/2021	Flynns Beach - centre	05268683	Left tarsus	Yellow 91	Left tibia	Chick	
06/04/2021	Kitty Miller Bay	05268684	Left tarsus	Yellow 92	Left tibia	Chick	

RECOMMENDATIONS

Hooded Plovers

- Considering the lower egg to chick survivoral rate (27.72%) for the 2020/21 Hooded plover breeding season as compared to the 2013/14 – 2017/18 period average (44.10%), 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).
- Preliminary data from the nest camera trap pilot study demonstrated the efficacy and validity of remote camera traps at nesting sites to capture footage of nest failure events in supporting reactive predator management, which has been noted as a useful management strategy in the past. It is recommended that this pilot 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 (*Millowl*). 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 (see 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 MyBeachBirds portal remains a vital tool in the management of Phillip Island's (*Millowl*) Hooded plover population. All portal entries by volunteers during the 2020/21 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 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.

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 (*Millowl*). Furthermore, the current extent and status of their populations on the Island largely remains unknown as well. It is, therefore, recommended that active and continued 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 2020/21, ongoing monitoring of the 2019/20 breeding site is recommended. Additional is that any breeding sites are placed on the MyBeachBirds portal and habitat sites are managed in the future. In the event that the birds return, signage and more frequent monitoring should be implemented.

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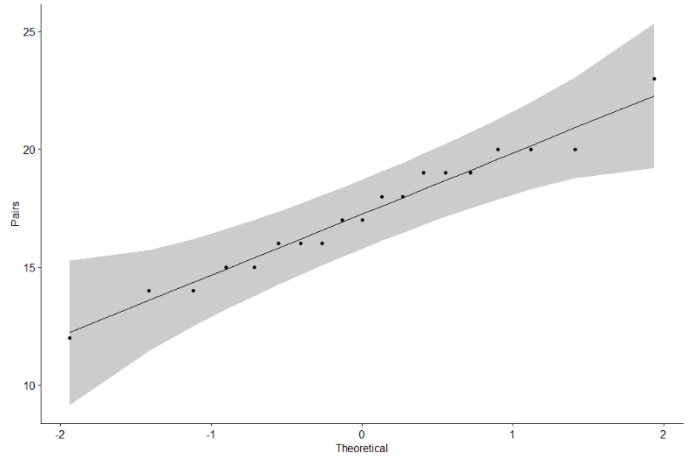
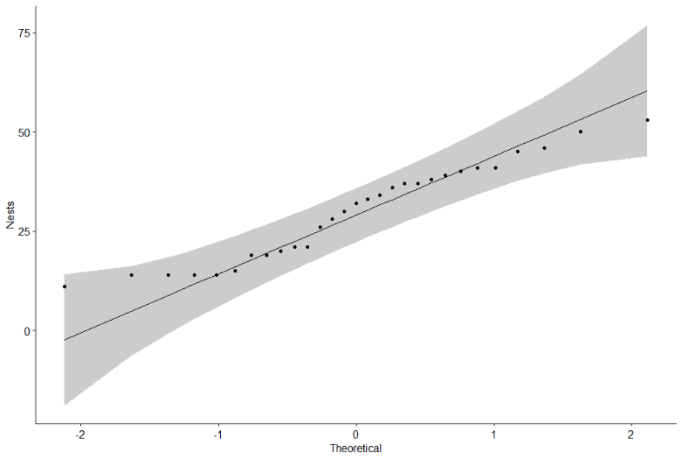
Appendix A: Hooded plover nesting site summary table 2020/21

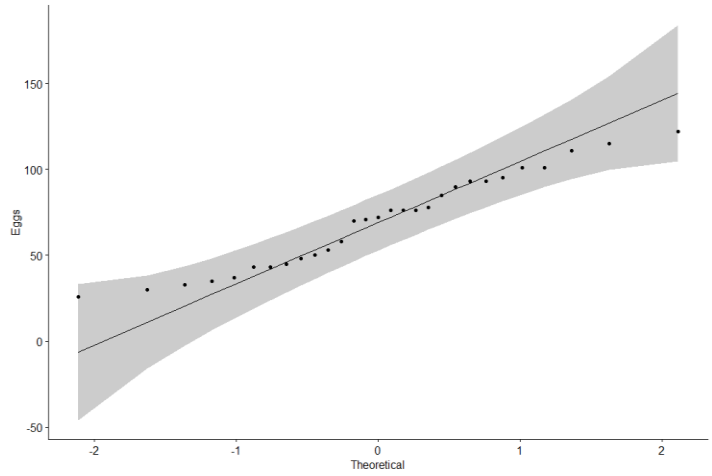
Nest	Location	Find Date	Adult Bands	Clutch No.	Eggs	Chicks	Fledge Date	Fledged	Chick Bands	Last Date
1	Anchorage Rd	31/08/2020	OLF 'EZ' UB	1	3	3	9/11/2020	3	YLF '78' YLF '79' YLF '80'	
2	Magiclands	18/09/2020	YLF '66' UB	1	1				failed	24/09/2020
3	Crazy Birds	23/09/2020	YLF '19' UB	1	3	2	24/11/2020	2	YLF '81' YLF '82'	
4	Anderson Boat Ramp east	28/09/2020	metal band UB	1	3				failed	5/10/2020
5	Woolamai SLSC west	2/10/2020	WLF 'RL' WLF 'JL'	1	3				failed	4/10/2020
6	Ventnor - Devon Ave	8/10/2020	YLF '23' UB	1	3	3	17/12/2020	2	YLF '83' YLF '84'	
7	Smiths Beach far east	14/10/2020	UB UB	1	3				failed	22/10/2020
8	Silverleaves east	20/10/2020	UB UB	1	3				failed	27/10/2020
9	Magiclands	20/10/2020	YLF '66' UB	2	2				failed	22/10/2020
10	Forrest Caves west	22/10/2020	OLF 'BR' UB	1	2				failed	26/10/2020
11	Red Rocks	26/10/2020	OLF 'PX' UB	1	3				failed	12/11/2020
12	Woolamai SLSC	29/10/2020	WLF 'RL' WLF 'JL'	2	2	1	6/01/2021	1	YLF '85'	6/01/2021
13	Silverleaves east	4/11/2020	UB UB	2	1				failed	5/11/2020
14	Flynns Reef	9/11/2020	YLF '12' UB	1	3				failed	19/11/2020
15	Forrest Caves centre	9/11/2020	OLF 'BR' UB	2	1				failed	11/11/2020
16	Smiths Beach east	10/11/2020	UB UB	2	1				failed	16/11/2020
17	Anchorage Rd	12/11/2020	OLF 'EZ' UB	2	3				failed	25/11/2020
18	Colonnades	19/11/2020	YLF '03' UB	1	2				failed	27/11/2020
19	Forrest Caves centre	20/11/2020	YLF '31' YLF '49'	1	1				failed	26/11/2020
20	Smiths Beach far east	23/11/2020	UB UB	3	2				failed	23/11/2020
21	Anzacs east	25/11/2020	OLF 'CH' UB	1	2				failed	4/12/2020
22	Anzacs west	27/11/2020	green metal UB	1	3				failed	18/12/2020

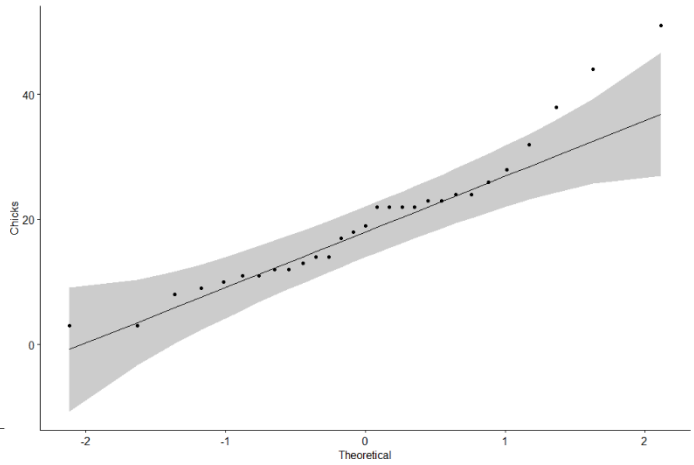
23	Surf Beach (Park St)	30/11/2020	WLF 'CU' UB	1	2				failed	4/12/2020
24	Farm Beach	3/12/2020	YLF '12' UB	2	3				failed	16/12/2020
25	Berrys Beach west	4/12/2020	OLF 'DM' OLF 'CD'	1	1				failed	10/12/2020
26	Forrest Caves east	4/12/2020	YLF '31' YLF '49'	2	2				failed	11/12/2020
27	Kitty Miller Bay	9/12/2020	YLF '21' UB	1	2	2			failed	22/01/2021
28	Anchorage Rd	11/12/2020	OLF 'EZ' UB	3	3	2			failed	7/01/2021
29	Anzacs	14/12/2020	OLF 'CH' UB	2	2				failed	24/12/2020
30	Silverleaves west	14/12/2020	UB UB	3	3	2			failed	4/02/2021
31	Forrest Caves east	16/12/2020	YLF '31' YLF '49'	3	2				failed	18/12/2020
32	Forrest Caves centre	20/12/2020			1				failed	24/12/2020
33	Surf Beach (Park St)	24/12/2020	WLF 'CU' UB	2	1				failed	29/12/2020
34	Crazy Birds	28/12/2020	YLF '19' UB	2	3	1			failed	27/01/2021
35	Farm Beach	30/12/2020	YLF '12' UB	3	2				failed	20/01/2021
36	Ventnor - Devon Ave	30/12/2020	YLF '23' UB	2	3	3		0	YLF '88' YLF '89' YLF '90'	
37	Forrest Caves east	30/12/2020	YLF '31' YLF '49'	4	1				failed	6/01/2021
38	Surfies Point west	5/01/2021	WLF 'CU' UB	3	1				failed	15/01/2021
39	Smiths Beach far east	5/01/2021	UB UB	4	3	1	10/03/2021	1	YLF '87'	
40	Forrest Caves centre	15/01/2021	OLF 'BR' UB	3	3				failed	28/01/2021
41	Colonnades	29/01/2021	YLF '03' UB	2	2				failed	
42	Magiclands	3/02/2021	YLF '66' UB	3	2				failed	12/02/2021
43	Flynns beach - centre	5/02/2021	YLF '12' UB	4	2	2	8/04/2021	1	YLF '91'	
44	Anchorage Rd	9/02/2021	OLF 'EZ' UB	4	3	2			failed	
45	Woolamai SLSC west	10/02/2021	WLF 'RL' WLF 'JL'	3	2	2			failed	11/03/2021
46	Kitty Miller Bay	12/02/2021	YLF '21' UB	2	2	2			YLF '92'	

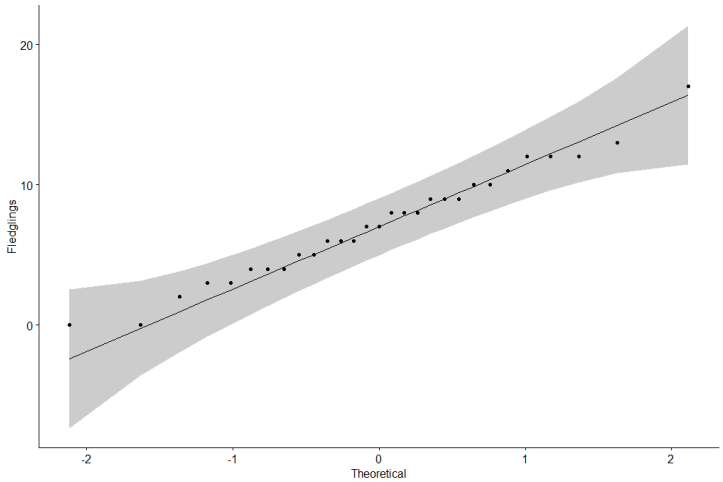
Appendix B: QQ plots for nesting variables











Appendix C: Nesting site summary table for Pied oystercatchers, Sooty oystercatchers and Red-capped plovers 2020/21

Species	Nest	Location	Find Date	Adult Bands	Clutch No.	Eggs	Expected Hatch Date	Chicks	Fledged	Chick Bands
POC	1	Observation Point	16/10/2020	?	1	2				failed
POC	2	Observation Point	6/11/2020	?	1	2				failed
POC	3	Observation Point	6/11/2020	YLF A7 YLF D5	1	2				failed
POC	4	Observation Point	6/11/2020	RLF 3P RLF 5C	1	2		2	1	UB
POC	5	Kitty Miller Bay	3/12/2020		1	1				failed
SOC	1	Summerlands Beach east	3/11/2020	UB	1	2	3/12/2020	2		failed
SOC	2	Shelley Beach	5/11/2020	UB	1	1				failed
SOC	3	Cowrie Beach	12/11/2020	UB	1	2	12/12/2020			failed
SOC	4	Cowrie Beach	12/11/2020	UB	1	2	12/12/2020			failed
SOC	5	Shelley Beach	25/11/2020	UB	2	2				failed