Breeding Success of the White-fronted Plover

Report on the 2023/2024 breeding season and overall impact of the project

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SUMMARY

Ground-nesting shorebirds are notably vulnerable to beach visitors in high-tourism areas. Following the worldwide trend of shorebird population decline, the White-fronted Plover (WFPL) (*Charadrius marginatus*) population has undergone a 37% reduction in numbers over the last three decades. We used an experimental approach to determine the human impact on shorebird survival on four sandy beaches along the Garden Route: Nature's Valley (experimental site), Keurbooms (citizen science site), Lookout (experimental site) and Robberg (control site). Experimental sites were subject to a conservation intervention which included erecting basic rope and signage at a 30m x 30m area around individual WFPL nesting sites. During our first experimental season, 2015/2016, we encountered 83 nests with a total of 152 eggs from 35 pairs of White-fronted Plovers. Of the 152 eggs only 58 chicks hatched successfully and a mere 15 fledged. This baseline data suggested a fledge rate of 26% and an overall breeding success rate of 9.8% across beaches in the Bitou Municipality area. Five years later, we began an intensive three-year experimental study between the 2021/2022 to 2023/2024 seasons. Over the three-year study period and compared to the baseline data, we found that experimental sites increased in breeding success (Nature's Valley: 36%; Lookout: 20.8%), but the control (Robberg: 6.6%) and citizen science (Keurbooms: 2.5%) sites decreased in breeding success. Across all sites, the final year produced a total of 180 eggs, 48 chicks and 23 successful fledglings resulting in a fledge rate of 47.9% and overall breeding success of 12.8%, a significant increase from the baseline.

2023/2024 BREEDING SEASON

OVERVIEW

This season was the final year for data collection on White -fronted Plover (WFPL) breeding success on our four study sites: Robberg (control), Lookout (experimental), Keurbooms (experimental - citizen science) and Nature's Valley (experimental) beaches (**Figure 1**). Monitoring began in early August 2023 and ended in early April 2024, resulting in an 8-month monitoring season. The nesting period began in mid-August, with the first nest recorded on the 10th of August on Robberg beach. The WFPLs on Lookout and Keurbooms beaches shortly followed suit, but those on Nature's Valley had a lazy start to the breeding season with the first nest only recorded over two months later, on the 19th of October. The latest recorded nesting attempt for this season was on the 10th of February.

Figure 1. Map of the four sites used to monitor White-fronted Plover breeding success.

October was equally saddening as it was rewarding as the shorebirds dealt with the aftermath of harsh storms that raked through the Western Cape. Robberg, Keurbooms and Nature's Valley beaches all experienced a great reduction in nesting habitat as the high swell carved out large proportions of the incipient dunes (**Figure 2**). A number of vulnerable WFPL nests were swallowed up in the process. **Photo 1** was taken on Nature's Valley and represents dune damage seen along other portions of the study sites, particularly Keurbooms and Robberg. The dune system on Lookout Beach remained intact, but flooding of the low-lying areas still wiped out a number of active nests.

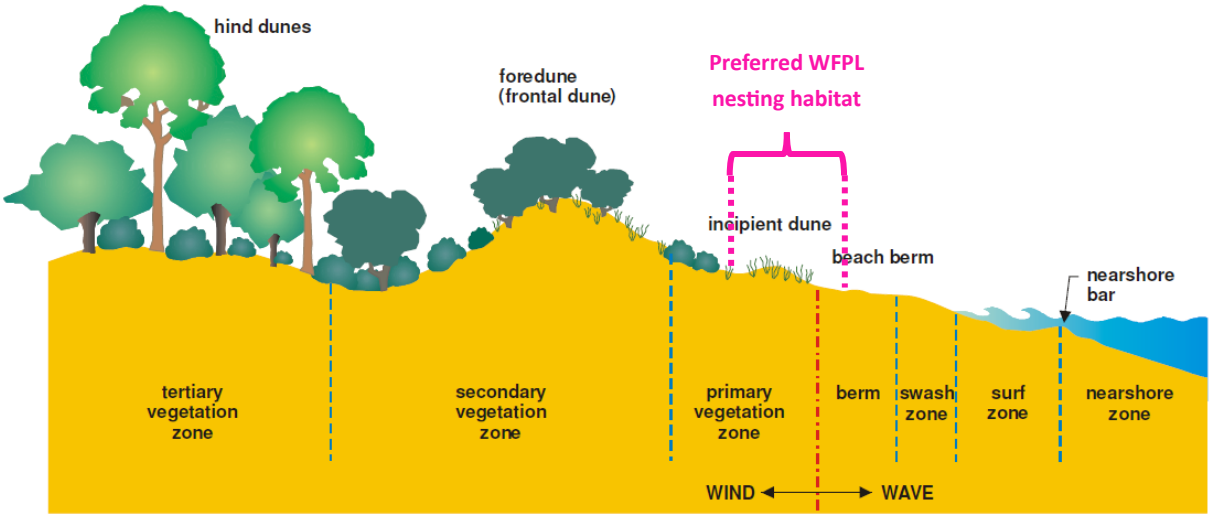


Figure 2. Typical zonation of a coastal dune system. The preferred nesting habitat of White-fronted Plovers (WFPLs) is in the incipient dunes and upper beach berm (source: NSW Department of Land and Water Conservation, 2001).

Photo 1. A portion of damage caused by the September storm in Nature's Valley. This dune section is no longer suitable nesting habitat for White-fronted Plovers as the incipient dunes have been completely removed by wave action.

RESULTS

For ease of reference, I will refer to the breeding seasons as year 1 (2021/2022 season), year 2 (2022/2023 season) and year 3 (2023/2024 season). In year 3, a total of 102 WFPL nests were found and monitored across all four study sites. This amounted to 180 eggs, 48 hatchlings and 23 fledglings (**Table 1**) and an overall breeding success of 12.8% (assuming that all nests with an unknown outcome

were considered unsuccessful). Despite the decrease in available nesting habitat after the early-season storms, both experimental sites performed very well and have significantly increased in breeding success since the previous season in year 2.

Table 1. The total eggs, hatchlings, fledglings, failed nests and breeding success for the 2023/2024 breeding season of White-fronted Plovers. The "best case scenario" includes possible fledglings from nests where the outcome was unknown.

Site	Total eggs	Hatchlings	Fledglings	Best case scenario	Failures (nests)	Breeding success
Nature's Valley	25	14	9	12	10	36%
Keurbooms	77	13	2	11	61	2.5%
Lookout	48	13	10	13	31	20.8%
Robberg	30	8	2	9	21	6.6%
Total	**180**	**48**	**23**	**45**	**123**	**12.8%**

The vast majority (77%) of the nests monitored, failed. This means that either the eggs or chicks died before fledging for a particular reason. The causes of mortality can be very difficult to monitor and are based on the available evidence and the observer's best judgement. Where the evidence was not obvious (which was often the case when chicks went missing) or too much time had passed to make an accurate assumption, the cause was categorised as "unknown". Of the failed nests, 46% were lost due to predation, 37% to unknown causes, 8.2% to storms, 3.5% were flooded (often due to poor placement of nests, e.g., below or on the high tide line), 1.2% to stress, and 1.2% were unviable eggs (**Figure 3**).

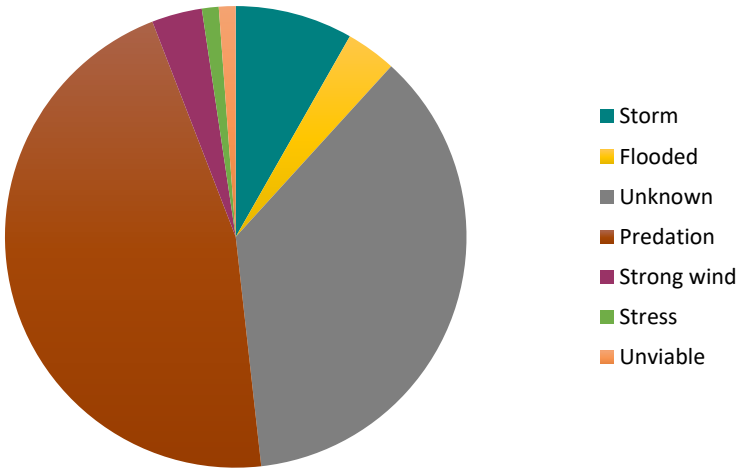


Figure 3. Causes of mortality for chicks and eggs across all sites.

The 1.2% related to stress was a very sad event on Nature's Valley beach for which I was present. There were two nests occurring unusually close to one another and both had two chicks, all less than 10 days old. We had just ringed the chicks from one of the nests, which is already a very stressful experience for them, and one chick was returning to a hiding place while its parents were frantically calling it. Then an adult bird, a parent from the neighbouring nest, swooped down on the chick, knocking it hard to the floor. Because this commotion was something I was responsible for, I ran back in to rescue the

chick and place it out of sight of the attacking bird. The poor thing was so stressed and shocked that it couldn't even run away from me. I backed up immediately to give the family space, but when I returned the next day to find out whether it had recovered, it was nowhere to be seen. Its sibling was well, but I could not find the chick running around with its family, nor its body where I had hidden it. I can only assume that the chick had died soon after the incident and that its body was taken by a predator.

Nature's Valley (experimental)

Over year 3, 15 WFPL nests were found on Nature's Valley beach (**Figure 4**). No nesting attempts were made on the eastern section of the beach, across the Grootriver mouth due to the lack of nesting habitat after the storms. The breeding pair that normally hold territory there were not recorded this season, so they may have moved off to a beach outside of this study's scope.

The WFPLs at the Nature's Valley site produced 25 eggs, resulting in 14 hatchlings, of which 9 were successful fledglings. This resulted in a 36% breeding success rate. Although they had a slow start to the season, they were by far the most successful this year.

Figure 4. The 16 nesting locations recorded on Nature's Valley beach (3 km), an experimental site, over the 2023/2024 breeding season. Note that this is not the most recent satellite imagery, sand banks have shifted slightly over time.

Keurbooms (citizen science/experimental)

Keurbooms took a knock this year with a significant amount of suitable breeding habitat (the fore- and incipient dunes) being lost to the September/October storms. The plovers responded to this change by nesting closer to the back of the dunes, where the vegetation is thicker and mammal predators, such as mongoose and wildcats are more common. Additionally, they often nested at the bottom of the dunes, where the high tide or spring tide would wash it away. A total of 42 nests were found across the whole of Keurbooms, producing a large number of 77 eggs, but only 13 hatchlings and a mere 2 fledglings resulted from their great effort (**Figure 5**). Their breeding success rate has had a significant

drop since year 1, which revealed a very impressive 44.4%. This declined to 2.9% in year 2, and even further down to 2.5% this year. This massive difference is due to differences in surveying effort for each season (**Table 2**), but is also likely due to observer bias.

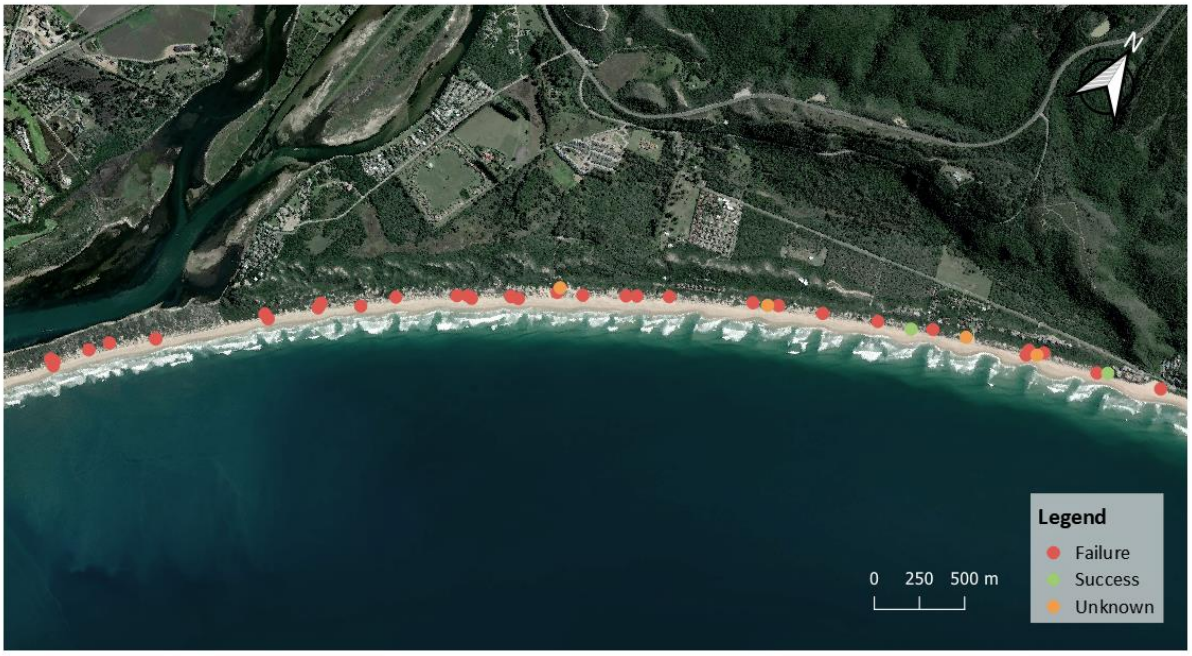


Figure 5. The 42 nesting locations recorded on Keurbooms beach (7.1 km), the citizen science site, over the 2023/2024 breeding season. Note that this is not the most recent satellite imagery, sand banks have shifted slightly over time.

Table 2. The number of nests and eggs found in relation to surveying effort (number of site visits per season) and breeding success for the Keurbooms citizen science site. Surveying effort is broken up into "head observer" and "citizen scientist observer".

Season (year)	Number of nests found	Number of eggs	Number of successful fledglings	Surveying effort		Breeding success (%)
				Head observer	Citizen scientist	
2021/2022 (year 1)	8	16	7	7	8	44.4
2022/2023 (year 2)	48	92	9	19	19	2.9
2023/2024 (year 3)	42	77	2	14	4	2.5

In this case, observer bias presents itself in the differing skill levels of our citizen scientists. One individual may be a natural at tracking down (often difficult to spot) WFPL nests, while another may have difficulty in finding them. This can skew the data significantly as many nests can go unseen by unskilled observers. Citizen science observers need to undergo repetitive training sessions with a skilled observer to ensure confidence in their reports.

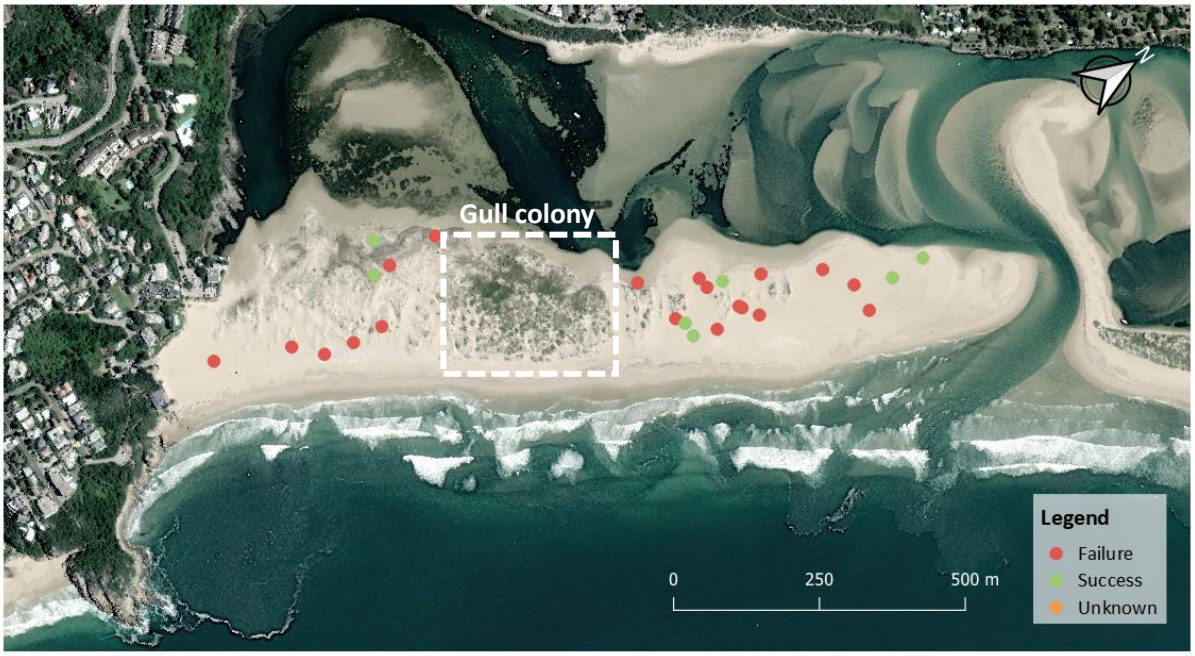
Our citizen scientists continued to show enthusiasm for conserving WFPLs along Keurbooms. Those who surveyed the west side of Keurbooms (coming from Plett Manor) showed incredible capability and dedication, sharing regular reports of new or failed nests. Those who surveyed on the east side (mainly coming from The Dunes Resort) struggled to track down nests, but were thorough in placing awareness signage along dune areas and reporting on damaged beach signage along Keurbooms. Much of the damaged signage was related to dog regulations, so it was not clear to visitors where the dog-friendly and no-dog zones were along Keurbooms. The information shared by them led to a full Bitou Beach Signage Report being conducted across all study sights which was shared with all relevant stakeholders including municipal agents, tourism operators and other conservation partners. We hope to see some new, clear dog regulation and coastal ecology signage being erected soon.

Lookout (experimental)

Lookout beach represents the only, albeit relatively small, dune field in this study. In the centre is a large gull colony which put significant predatory pressure on the WFPL population here. However, the lagoon and sandspits around the river mouth here also serve a very popular 'club house' for WFPLs, where individuals from Keurbooms also often visit for feeding or finding mates.

The Lookout population performed well this year with 28 nests found, producing 48 eggs, 13 hatchlings and 10 fledglings resulting in a breeding success rate of 20.8%. Notably, lookout also had the highest hatchling success rate (hatchlings making it to fledge) at 76.9%. Indeed, the chicks were often very difficult to find and catch given the large area of dune for them to utilise and hide in. Egg success, on the other hand, was second lowest, presumably due to high predation pressure by Kelp Gulls, being so close to the breeding colony (**Figure 6**).

Figure 6. The 28 nesting locations recorded on Lookout beach (0.25 km^2), an experimental site, over the



2023/2024 breeding season. Note that this is not the most recent satellite imagery, sand banks have shifted slightly over time.

There was once chick that was sadly found dead at Lookout during a survey in early December. There was no obvious sign for the cause of mortality, but there was some blood around its bill (**Photo 2a**). This may have been a disease case or another a situation as described above, where another adult plover may have killed it. This kind of behaviour is quite common in the animal kingdom as individuals fight for their own genes to be successful. On a lighter note, Lookout also produced the first successful fledgling of the season in late December (**Photo 2b**).

a)  **b)** 

Photo 2. a) A White-fronted Plover chick found dead at Lookout beach in December. The cause of death could not be determined. **b)** The first fledgling of the season.

Robberg (control)

The WFPL population at Robberg struggled the most this season, having produced only 16 nests, 30 eggs, 8 hatchlings and 2 fledglings, resulting in a breeding success of 6.6%. There are still distinct sections of the beach that are used for nesting, presumably where it is not as busy with people. The human activity on Robberg has been significant, with swimmers, tanners, walkers, joggers, dog walkers, yogis, etc. Despite efforts to educate people, most are unaware of the breeding shorebirds when they come for their beach activities.

Figure 7. The 16 nesting locations recorded on Robberg beach (4.3 km), the control site, over the 2023/2024 breeding season. Note that this is not the most recent satellite imagery, sand banks have shifted slightly over time.

AN UNINTENTED OUTCOME

By sectioning off the dunes where nests were found, we have inadvertently facilitated dune protection. Beach visitation rates increase exponentially in the summer time on the Garden Route which puts a lot of pressure and disturbance to the coastal system. The increased foot traffic often results in degradation of the dune face as plants are trampled and sand is pushed down the dune. Nature's Valley produced particularly clear evidence that sectioning off the dunes can make a huge difference to dune recovery, particularly after storms or big wave action that cut out the incipient dunes.

I have a specific example from Nature's Valley where, during the big storms in September/October of the 2023/2024 season, much of the incipient dunes and the vegetation was removed. However, by sectioning off the nesting areas on the dunes from people, hundreds of the pioneer Sea pumpkin (*Arctotheca populifolia*) seedings were able to establish. Pioneer species play in important role in stabilising the sand and creating more humid, cooler microhabitats for other plant species to germinate and establish. When there is disturbance to the sand, the pioneer seedings can be easily buried and then do not survive. The emergence of the Sea pumpkin occurred in the busiest month of the year – December – and the difference in sand disturbance (and occurrence of seedings) inside and outside the sectioned off area was very distinct (**Photo 3**). Five months later, in May 2024, there is already a notable difference in dune formation and stabilisation as the Sea pumpkin holds the sand in place.

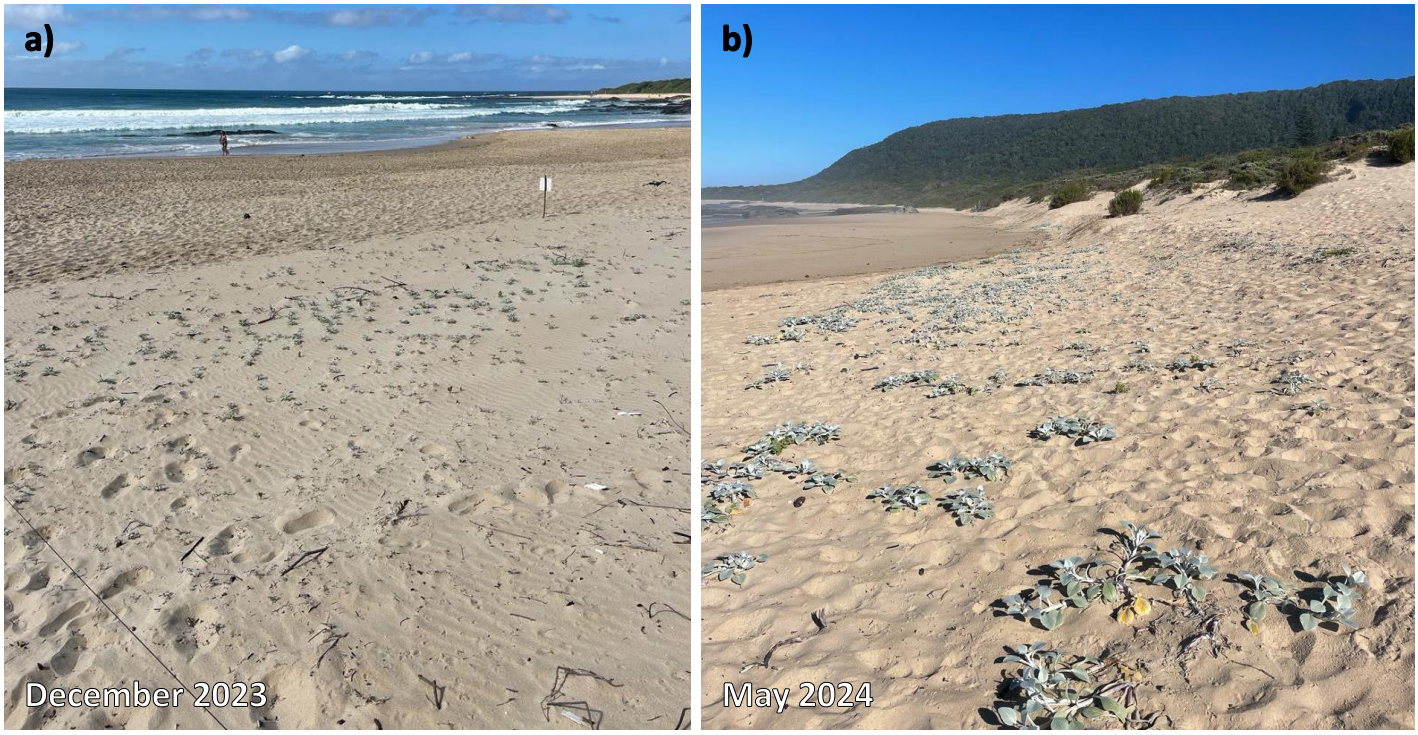


Photo 3. The emergence and progression of the same patch of Sea pumpkin (*Arctotheca populifolia*) seedings on Nature's Valley beach **a)** in a sectioned off nesting area during the busy month of December 2023 when the seedings were emerging, note the difference in sand disturbance outside and inside the enclosure; and **b)** five months later in May 2024 as mature plants.

CONCLUSION

Both experimental sites (Nature's Valley and Lookout) performed well and showed a marked increase in breeding success compared to previous seasons which is very encouraging. Productivity on our citizen science site (Keurbooms) is good, but breeding success has been very low, likely due to observer bias, predation and lack of suitable nesting habitat since the early season storms. The control site (Robberg) performed poorly and had a relatively unproductive season considering the length of beach available there. This was likely due to the level of disturbance those bird experience on a daily basis, as well as a lack of suitable habitat since the storms.

OVERALL EFFECT OF THE PROJECT: 2021-2024

OBSERVED IMPACT OF THREATS

As we know, the WFPLs face a range of threats, all of which are interconnected and influence the impacts of other threats. The most obvious are:

- Predators
- Coastal development
- Climate change
- Harsh environmental events
- Unaware beach-goers
- Dogs

The population of WFPLs along the Garden Route battle against these threats throughout each year. Unfortunately, the tourist season for the Garden Route coincides with the shorebird breeding season which can have a huge impact on breeding success. The overarching threats experienced by WFPLs on the Garden Route are unaware beach-goers and dogs. Dogs could fall under the category of "predators" as they are known to eat the eggs and chase down chicks, but because they are technically an anthropogenic influence on the environment, they need to be recognised as a separate threat. In partnership with NVT, Plett Tourism, PAWS and the Ratepayer Associations of Plettenberg Bay, Keurbooms and Nature's Valley, Bitou Municipality launched dog zonation on beaches, from Robberg to Nature's Valley (**Figure 8**). This effort primarily addressed the impact that dogs have on the coastal environment, including breeding shorebirds. For the most part, residents respect the regulations and agree with the implementation thereof, however, there are still issues with a few defiant residents and ignorant (or unaware) visitors who unleash their dogs on no-dog zones. Human disturbance and dogs are more impactful where there is more coastal development. In this case, Robberg experiences the worst of it.

Figure 8. Example of the dog zones on Nature's Valley beach.

Other noticeable impacts on WFPL breeding success have been predation, harsh environmental events and climate change. Predation is a natural process and will fluctuate over time as predator-prey

populations rise and fall in sequence. Predation normally occurs on eggs and chicks and is virtually unheard of for adult WFPLs given that they can fly and have quick reflexes. The predominant predatory animals include Kelp Gulls (**Photo 3**), raptors such as Rock Kestrels, White-backed Ravens and Pied Crows, mongooses, and wildcats. It is expected that predation pressure will be greater on beaches with a healthy, complex hind dune and foredune system, particularly predation from mammals that live in the thicker dune vegetation. Beaches with encroaching coastal development, like Robberg, will likely suffer fewer mammal predations as human disturbance drives predators out of the system. More intact sites include Nature's Valley and Keurbooms, but further research should be conducted on habitat complexity (vegetation and predator surveys) to determine the predatory pressure experienced by each site because they all differ in ecosystem health and complexity.

Photo 3. Kelp Gulls seen on Lookout Beach during a survey. These birds are often overlooked as predatory species, but they can have a mean bite.

Climate change and harsh weather events go hand-in-hand as weather events like storms, heat waves, cold spells and strong winds intensify with climate change. There is no doubt that the effects of sea level rise predicted to occur with climate change will also have a great impact on WFPLs and many other coastal breeding birds as wave action carves out their nesting habitat. This will likely have a greater impact on narrower beaches first, including the whole of Robberg and Nature's Valley as well as the west side of Keurbooms. Because Lookout is a dune field, there will be greater protection on the interior.

EFFECTIVENESS OF CONSERVATION INTERVENTION

Over the course of this 3-year project, 236 nests were found and monitored. The two experimental sites (Lookout and Nature's Valley) have had a general upwards trend in total breeding success since year 1. However, the opposite was found for the control (Robberg) and the citizen science site (Keurbooms) (**Figure 9**).

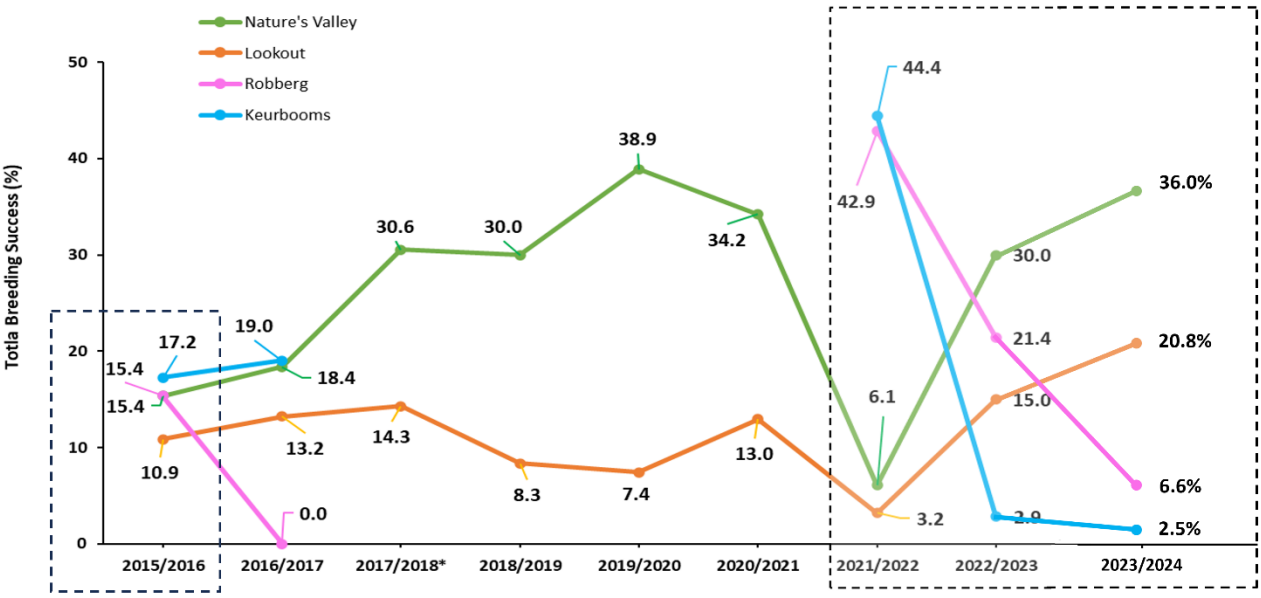


Figure 9. Total breeding success trend of White-fronted Plovers across the two experimental sites (Nature's Valley and Lookout), the citizen science site (Keurbooms) and the control site (Robberg) from the 2015/2016 season to the 2023/2024 season. Robberg and Keurbooms beaches were not monitored between the 2017/2018 season and the 2020/2021 season.

Overall, egg survival increased for the experimental sites over the three seasons of monitoring. Although the Nature's Valley WFPLs egg survival decreased slightly in year 3, there is still a significant improvement since year 1 (**Figure 10**). Egg survival at the citizen science fluctuated, but ended up with higher survival in year 3 than year 1. The control site egg survival barely changed throughout the monitoring period, but had a very slight improvement by year 3.

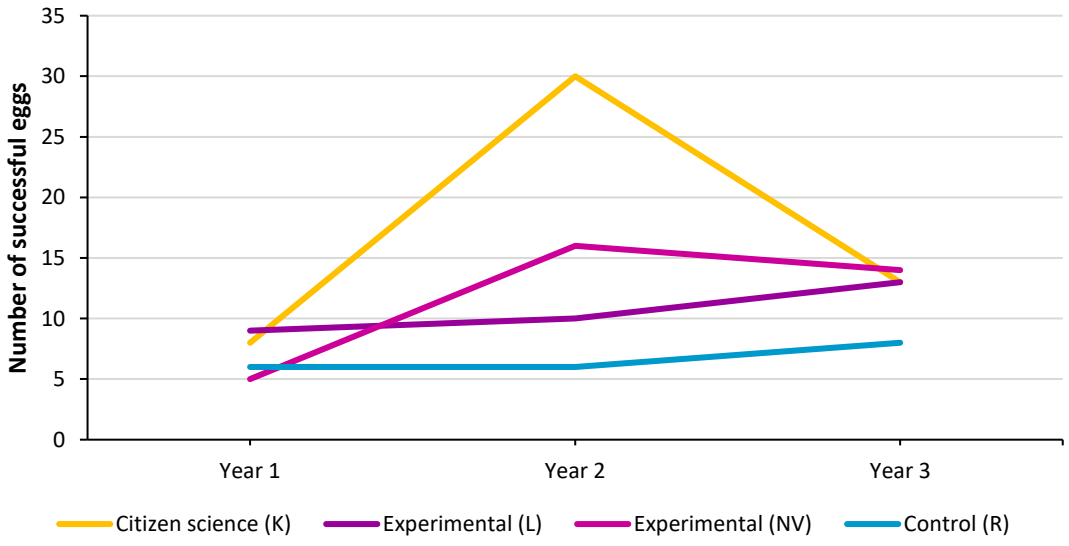


Figure 10. Egg survival across all four sites, Keurbooms (K), Lookout (L), Nature's Valley (NV) and Robberg (R) over the three seasons of monitoring.

Hatchling survival drastically improved for both experimental sites since year 1, with Lookout improving linearly and Nature's Valley plateauing at a very reasonable survival rate after year 2 (**Figure**

11). On the other hand, the citizen science site had a sharp decline in hatchling survival between year 2 and 3, however this result may have been impacted by surveying effort (**Table 2**). The control site showed a reduction in hatchling survival after year 2. This may have been due to the effects of the storm having narrowed the dune area, resulting in the plovers having closer contact to human disturbances.

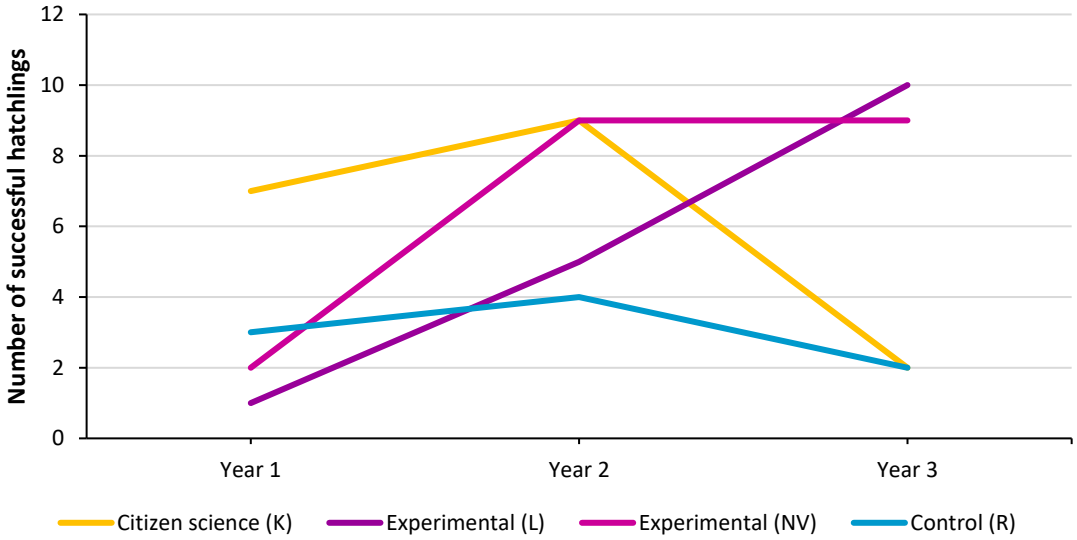


Figure 11. Hatchling survival across all four sites, Keurbooms (K), Lookout (L), Nature's Valley (NV) and Robberg (R) over the three seasons of monitoring.

The implementation of nesting 'enclosures' has proven to be successful over the last three years (**Figure 12**). Apart from physically excluding people from nesting areas, the enclosure intervention on the experimental sites creates awareness through the associated signage. With greater exposure to the signage, people become more familiar with the birds, enjoy their presence and respect their space as a result. Our experience at Robberg has been very different without the enclosure intervention.

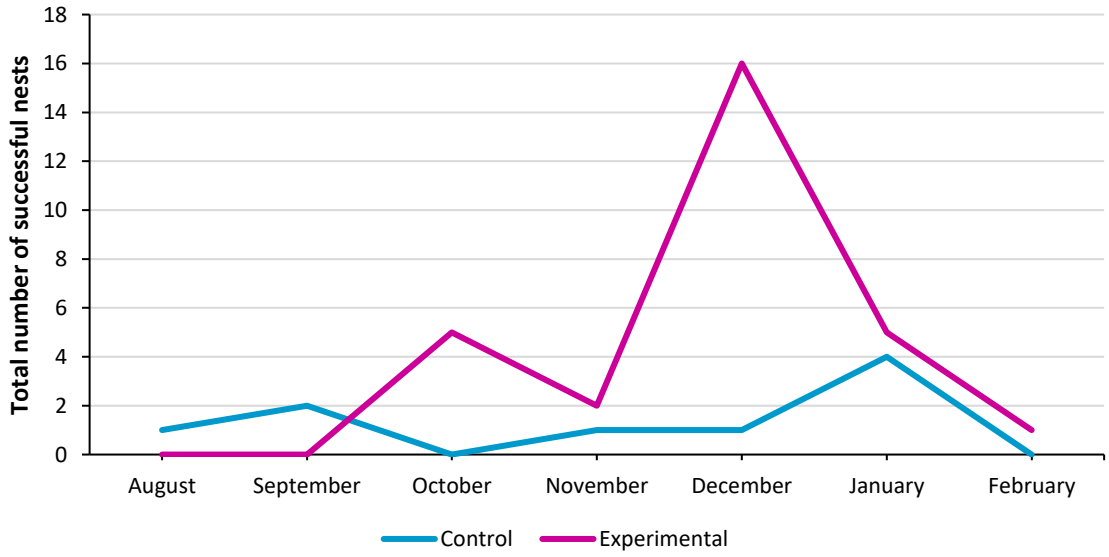


Figure 12. The total number of successful nests at the control site (Robberg) and the experimental sites (Lookout and Nature's Valley) over the monitoring period.

Despite efforts to educate local people through the #ShareTheShores campaign and spread the word through partner organisations and institutions, most people are unaware of breeding shorebirds when they come to Robberg for their beach activities and cause fatal levels of disturbance to the breeding WFPLs.

In saying the above, it is important to acknowledge that each of these four coastal systems are quite different in terms of habitat quality, degree of coastal development, size, predation pressure, disturbance and diversity. Although the experimental sites seem to have had greater success as a result of the intervention, which very well may be the case, there may be more to the story. Additional studies, such as vegetation surveys, predator surveys and quantification of human impact, are needed to support the idea that the intervention is the reason for success at these sites.

REFERENCES

NSW Department of Land and Water Conservation, (2001). *Coastal Dune Management: A Manual of Coastal Dune Management and Rehabilitation Techniques*. Coastal Unit, DLWC, Newcastle.