

Evidence-based practice

## Breeding management of little penguins (*Eudyptula minor*) in a captive setting: A case study of fostering chicks

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**Abstract**

The captive management of a breeding population of little penguins (*Eudyptula minor*) often requires innovative thinking as little or no current research exists to aid in negotiating problems that arise. Between 2010 and 2016, Melbourne Zoo recorded variable chick survival rates in its colony. This study identified parents neglecting their chicks as one cause attributed to this. Fostering of chicks is a relatively undocumented form of management intervention but was trialled during the 2016 breeding season in an effort to increase chick survival rate. The results of the trial were that little penguin chicks could be fostered under surrogate little penguin parents under specific circumstances. More trials are recommended to ensure the reliability of this management technique. It is hoped that the findings of this study will encourage the use of fostering chicks as a recognised management tool and be accepted as good husbandry practise worldwide.

### Background

Modern zoos have been showing an increased focus on animal welfare outcomes and conservation of species (Fernandez et al. 2009). When zoos ensure the animals within their care are provided with every necessity to live out fulfilling lives they are supporting good welfare (Whitham and Wielebnowski 2013). A part of this commitment includes participating in Regional Collection Plans and Population Management Plans (PMP) for every species (Diebold et al. 1999). In Australia, little penguins (*Eudyptula minor*) are the subject of a PMP and studbook that requires genetic and demographic analysis and management in order to support regional and global partnerships (Australasian Species Management Program 2017). Whilst they are largely managed for display this does not diminish the responsibility

or commitment of Zoos Victoria to provide the highest standard of management and care. As well as population management, Zoos Victoria acknowledges that there is a movement supporting individual animal welfare and therefore strives to have a comprehensive understanding of individual needs through focused scientific research (Whitham and Wielebnowski 2013).

Some species, such as little penguins, present management challenges and there is little or no research immediately available to aid in negotiating them in a captive setting. Brood reduction strategies are implemented by little penguins in the wild (Numata et al. 2004). Factors, such as decreased availability of resources and aged or inexperienced birds, can lead to one chick being favoured over a sibling in the same nest (Wienecke et al. 2000) and often can result in the death of the

neglected chick. Such situations present a challenge in terms of captive management and the keepers at Melbourne Zoo recognise this as an area of management that needs further research.

Between 2010 and 2016, Melbourne Zoo recorded variable little penguin chick survival rates during the breeding season (see Figure 1). Whilst there is no published data from other facilities for comparison, Melbourne Zoo recognises room for improvement based on the high animal welfare standards that the zoo sets itself. Secondly, the little penguin captive population at Melbourne Zoo will be more sustainable if the number of surviving chicks is improved.

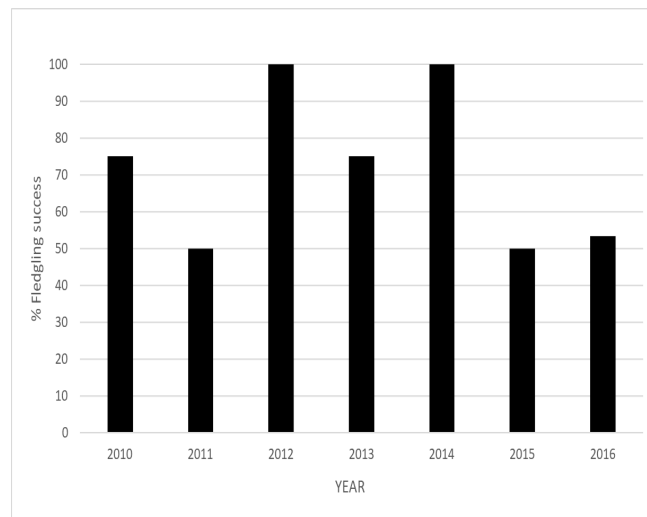
### Action

This is a descriptive study of penguin behaviour based on observations made by keepers during the little penguin breeding seasons between 2010 and 2016 inclusive. The breeding season at Melbourne Zoo usually begins in May or June and is distinguishable by a notable change in penguin behaviour. In the off-season they mostly congregate as a large social group standing or swimming together. Once breeding season commences, birds pair up and isolate themselves to a nest box which they monopolise and begin to dig out. Stahel and Gales (1987) noted that while wild birds generally begin nest building in September, it is not unusual for them to start as early as May when resources, such as food, are in abundance.

Melbourne Zoo currently has a hands-off approach to little penguin breeding. Birds choose their own partners, build their own nests, incubate eggs (given they are a genetically compatible breeding pair) and raise them until close to fledging age with minimal disturbance from keepers. Until 2016, keepers monitored breeding by opening the lid of the nest box three times a week to observe eggs and then once a week after hatching. However, at the start of the 2016 breeding season, all 14 penguin nest boxes were fitted with a network camera system. Six cameras were installed in the most commonly occupied boxes. These cameras allowed video monitoring of the interior of the boxes 24 hours a day with recordings saved for up to 2 weeks and the capability to review footage and export it to a hard drive. This enabled keepers to review penguin breeding management protocols and to minimise disturbance by monitoring via camera footage. This was carried out in an effort to maximise breeding success (measured as chick survival to fledging age) and to improve animal welfare.

Penguin breeding management not only requires good observational skills by the keepers but also relies on the ability to implement intervention protocols when needed. Intervention may include removing eggs when necessary, such as relating to health of the birds, reproductive experience, environmental or social conditions, goals of the reproductive programme, improper incubation, overdue hatching, replacement of eggs with dummy eggs, transportation of eggs to an incubator or fostering of eggs to another pair (AZA Penguin Taxon Advisory Group 2014). The latter is well documented across several penguin species and has proven to be a useful and successful breeding management tool. Intervention may also include removing chicks from nests due to factors including the death of a parent, health related issues of the chick or a failure for it to thrive. Traditionally, these chicks require hand rearing by keepers or veterinarians.

Fostering of chicks under surrogate parents of the same species is a lesser practised and poorly documented breeding management concept that is not referenced by the AZA Penguin Taxon Advisory Group (2014). It is hoped that the observations presented in this paper will provide further evidence to support the use of fostering chicks for penguin breeding management practice in other zoological institutions. It is also hoped that the concept will be recognised as good practice and in turn added to



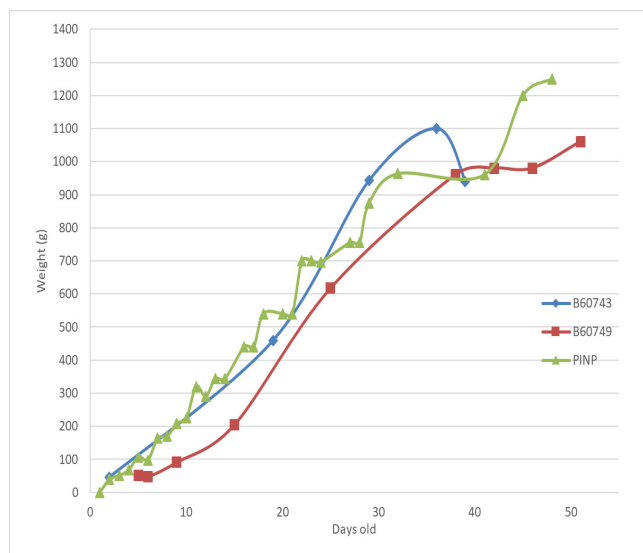
**Figure 1.** Little penguin fledgling success (number of chicks that survived to fledging age as a percentage of total number of eggs hatched) at Melbourne Zoo from 2010 to 2016.

the current husbandry manual for little penguins. The following cases describe two separate situations where intervention was performed at Melbourne Zoo.

#### Case one

Two eggs hatched in Box 13 on 1 December 2016 (B60742 and B60743). The sire, B50340, was a young (3 years old), inexperienced male. The dam, A20668, was an older (13 years old) female with a history of poor parenting. This was their first time as a breeding pair but their second clutch for the 2016 season. The first clutch had been incubated and hatched as normal in August; however, a significant size difference (chick A: 364 g, chick B: 91 g) was observed on the cameras when the chicks were around 10 days of age, indicating that the parents were favouring one sibling over the other. In this case, the underweight chick was pulled for hand rearing. This chick progressed well until it was 23 days old but then became unwell and passed away very suddenly without a conclusive reason. This was the second time dam A20668 had exhibited a brood reduction strategy causing one chick to be neglected. In January 2015, the exact same scenario had been observed, only the chick in this case was successfully hand raised and is now a part of the Melbourne Zoo colony.

On 2nd December 2016, keepers removed a 1 day old little penguin chick from Box 13 and placed it into Box 8 with two surrogate parents. The decision was made to pre-emptively remove one chick from Box 13 based on the poor parenting history of the dam and the lack of experience of her partner. The surrogate parents, B00847 and B40297, were chosen based on timing as well as a history of successful parenting. At the time of the move, the surrogate pair were incubating two eggs that were now six days past their expected hatch date. Keepers removed one of the eggs and candled it to determine if it was still viable. The egg was found to be infertile. Keepers broke open the infertile egg



**Figure 2.** Comparison of little penguin chicks, B60743 and B60749, against Phillip Island Nature Park average chick weights (document unpublished).

and flushed it with saline. Meanwhile, both chicks from Box 13 were weighed and the lighter of the two was chosen to be moved to the surrogate nest. Keepers blocked the entrance of Box 8 while the surrogate female was incubating the remaining egg. The foster chick was gently placed inside the broken flushed egg shell and a small amount of nesting material from Box 8 was rubbed onto the chick and shell. The top of Box 8 was then opened. One keeper shielded the chick from the pecks of the female with their hand while another placed the foster chick as far under the female as possible. At the same time the remaining egg was removed and candled. It, too, was infertile. The lid was then closed and keepers monitored the following interactions for an hour via the camera footage. The entrance to the nest box was opened after 10 min.

#### Case two

One chick hatched in Box 10 on 2 December 2016 (B60746) and its sibling hatched in the same box on 5 December 2016 (B60749). The sire, A20706, and dam, B00114, were an established pair who had successfully raised chicks in previous seasons. This was the second clutch for this pair in the 2016 breeding season. Two chicks were successfully raised to fledging in their first clutch.

On 8 December 2016, keepers observed via camera footage that both parents were absent from Box 10. The two chicks, now 6 and 3 days old, had been left unattended for 4.5 hours. This was very unusual behaviour as the parents normally alternate guarding until they are between 2 and 3 weeks of age, at which point they can be left alone for periods of time (Chiaradia and Kerry 1999). The following day at around 1300, keepers checked the camera footage and noticed that the parents were once again missing from the nest box. The keeper also observed that the larger of the two chicks (B60746) had fallen onto its back and was struggling to right itself again. As the keeper continued to watch, the chick began to open mouth breathe and then slowly cycle its legs. The

chick was removed from the nest box and taken up to the vet clinic. It weighed 62 g at 7 days of age, significantly underweight according to data from Phillip Island Nature Park (PINP) (refer to Figure 2). Within the next hour, the smaller chick (B60749) also started to display the same signs of distress. It was also removed from Box 10 and taken to the vet clinic. It weighed 52 g at 4 days of age.

Both chicks were x-rayed, received fluids and hand rearing formula and were kept warm in an incubator while in vet care overnight. Unfortunately, the larger chick (B60746) died at around 1200 the following day. The smaller chick (B60749), however, appeared to have gained strength and showed an excellent feeding response.

On 10 December 2016 at 0845, B60749 was placed into surrogate Box 8, alongside chick B60743 from case one in this study. At the time, B60743 was 9 days old and the new foster chick B60749 was 5 days old. Whilst 4 days is a significant age difference, given the rate at which penguin chicks grow and considering the smaller chick was already underweight and undersize, it was decided the best option for the chick was to foster it rather than attempt to hand rear it.

Keepers blocked the entrance of surrogate Box 8 with the female guarding foster chick B60743. They then rubbed nesting material from Box 8 onto the new foster chick B60749. The lid of the nest box was then opened, one keeper protected both chicks by blocking the female with their hand, while another keeper placed the new foster chick under the female next to the first foster chick.

## Consequences

#### Case one

Observations from the camera footage showed that the female B40297 appeared alert and more interested in the presence of the keepers outside the box than the new chick underneath her. She was observed greeting the chick about 2 min later by putting her head down under her chest and gently shaking her head. The female then rocked sideways to move the chick into a more comfortable position in her brood pouch. At 1126, approximately 30 min after the chick had been placed into Box 8, the chick showed strong begging behaviour towards the female. She responded by feeding the chick multiple times in succession. The female continued to guard the chick for approximately 5 hours before the male B00847 returned to the nest box. On arrival, the male spent 5 min standing in the doorway to the box preening himself. He then moved towards the female and attempted to displace her; however, the female remained on the chick shaking her head. Both surrogate parents spent 2 min sitting in the bowl of the nest with the chick still mostly underneath the female. Eventually the male moved to the back of the bowl and pushed the female forward and off the nest. Once the male took over, the chick exhibited strong begging behaviour. The male immediately fed it several times in succession. Over the following 30 min, the parents continued to swap positions on the chick, with the male feeding the chick several more times. Eventually the female settled back into position and remained guarding for a further 4 hours before another swap occurred.

#### Case two

Observations from the camera footage showed that the female barely reacted to the new chick underneath her. After settling back down once keepers left she gently rocked back and forth and continued to sit, now on two chicks. The entrance to the nest box was opened after 10 min. Five minutes later the male surrogate entered the box and vocalised to the female. He remained in the entrance of the box preening himself for 15 min before taking over

from the female and guarding the two chicks. He then proceeded to feed both chicks several times within the first hour of caring for them.

The fostered chicks from both cases in this study were raised by the surrogate parents until they reached pulling age. The normal protocol for Melbourne Zoo is to pull both chicks from a nest when the youngest is 5 weeks old and then condition them to hand feed at a bucket. An exception was made in this case as the chick from case two was not as developed as the chick from case one. Case one chick, B60743, was pulled at 5 weeks of age and case two chick, B60749, was left for an additional 6 days with the parents before being pulled. Both chicks were fully fledged by about 8 weeks of age and were returned to the main colony once they had learnt to hand feed.

The two cases discussed above are the first accounts of fostering being implemented as a breeding management tool with little penguins at Melbourne Zoo. Initial discussions regarding the parameters required for fostering to be successful were conducted with Dr Peter Dann from Phillip Island Nature Parks. Dr Dann suggested that timing of fostering was crucial. Fostering would likely be more successful if the surrogate pair had been incubating eggs for the full period of incubation (35 days) or have one chick of the same age already in the nest that they were successfully feeding (personal correspondence 2016).

One study, by Davis and McCaffrey (1989), showed that wild Adelie penguin (*Pygoscelis adeliae*) adult surrogates did not discriminate against fostered chicks until 17–21 days post-hatching, and that the chicks may have learnt to discriminate parents around 11–15 days. Their study supports the use of fostering chicks as a penguin breeding management tool in circumstances where intervention is required to improve the chances of a penguin chick's survival and helps to set further timing parameters for introduction of foster chicks to surrogates.

Little penguin chicks requiring some form of intervention are likely to have compromised health, making success often even more difficult to begin with (personal experience). Further potential strategies for improving chick survival rates within zoological institutions include hand rearing, intensive monitoring of chick growth while still in the nest and in-nest supplementary feeding.

Hand-rearing is a management technique that has been utilised worldwide across a range of species (Kuehler and Good 1990). However, hand rearing is known to be time and resource demanding (AZA Penguin Taxon Advisory Group 2014).

Supplementary feeding was considered for case one chick, B60743, while it was still in Box 13 with its sibling. This would have required opening the nest box lid and tube feeding the chick. This type of intervention would likely only be possible when the parents leave the chicks unattended, otherwise the increased disturbance may impact breeding success (chicks reaching fledging age) of the pair. Giese (1996) showed that disturbance by nest checking wild Adelie penguins can significantly reduce breeding success. Little penguin parent birds usually start leaving their chicks unattended around 2 weeks of age (Chiaradia and Kerry 1999). However, Melbourne Zoo has encountered pairs that leave one parent bird guarding in the nest right up to and including 5 weeks of age.

This study was able to demonstrate that it is possible to foster little penguin chicks with little penguin surrogate parents under two different circumstances. It is recommended that further trials take place under a range of other situational variables to ensure that this practice is reliable. To maximise the potential for success when fostering, it is highly recommended that the organisation install an in-nest camera system to allow for constant observation of the interactions between surrogate parents and fostered chicks.

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