

Article

How to Count Parrots: Comparing the Performance of Point and Transect Counts for Surveying Tasman Parakeets (*Cyanoramphus cookii*)

Michael John Adam Skirrow ¹, Luis Ortiz-Catedral ^{1,2,*}  and Adam N. H. Smith ¹ 

¹ School of Mathematical and Computational Sciences, Massey University, Private Bag 102-904 North Shore Mail Centre, Auckland 0630, New Zealand; a.n.h.smith@massey.ac.nz (A.N.H.S.)

² Oceania Conservation Program, World Parrot Trust, Glanmor House, Hayle TR27 4HB, UK

* Correspondence: luis@parrots.org

Abstract: Obtaining precise estimates of population size and trends through time is important for the effective management and conservation of threatened species. For parrots (Psittaciformes: Psittacidae), obtaining such estimates can be challenging, particularly for cryptic species that occur in low densities in complex and/or fragmented habitats. We used a statistical resampling approach with the aim to compare the reliability and precision of counts for the critically endangered Tasman parakeet (*Cyanoramphus cookii*) that were taken using two methods on Norfolk Island (Pacific Ocean), namely, fixed-point counts and line transect counts. The detections obtained during fixed-point counts had better estimated precision (0.274) than line transect counts (0.476). The fixed-point method was also more efficient, yielding 1.338 parakeet detections per count compared to the 0.642 parakeet detections per count obtained by the line transect method. Although Tasman parakeets can be detected by either of these methods, our research demonstrates that the fixed-point method is more precise and reliable. These findings can help prioritise resources for the long-term monitoring of recovering populations of this species and similar island species.



Citation: Skirrow, M.J.A.; Ortiz-Catedral, L.; Smith, A.N.H. How to Count Parrots: Comparing the Performance of Point and Transect Counts for Surveying Tasman Parakeets (*Cyanoramphus cookii*). *Diversity* **2024**, *16*, 698. <https://doi.org/10.3390/d16110698>

Academic Editors: Sofia Solórzano, Luc Legal and Maria Del Coro Arizmendi

Received: 17 August 2024
Revised: 23 October 2024
Accepted: 28 October 2024
Published: 14 November 2024



Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Keywords: parrots; population monitoring; density estimates; point count; transect count; statistical resampling; Norfolk Island

1. Introduction

Determining the population size and density of at-risk species is a crucial component of species conservation and wildlife management research [1,2]. Estimates of population size and indices of density offer insight into population trends, extinction risk, species conservation status, population viability, the impact of different threats, and the effectiveness of species management [3–5]. Typically, obtaining these estimates requires counts of individuals observed or detected in the field [6,7], which can provide an index of relative density that can be compared across spatial units and/or through time [1,8,9]. Multiple factors can influence the variance of these counts and, thus, the precision with which the mean of indices may be estimated. These factors include the behavioural characteristics of the species of interest, the complexity of the habitat, the size and colouration of the study species, the experience of the observers conducting counts, and the season in which sampling occurs [10,11].

Increasingly, advances in technology and survey methods are allowing scientists to estimate relative densities with greater accuracy and precision. Novel approaches to surveying, such as the use of drones fitted with high-definition cameras, enable biologists to rapidly assess populations while reducing the error associated with ground-based survey methods [12,13]. In a recent study, Hodgson et al. [13] found data collected using drones were up to 96% more accurate than data obtained using traditional survey methods. Similarly, diver-operated stereo-video systems used in the assessment of marine biomass can

overcome observer biases such as the inaccurate estimation of distances, misidentification of species, and underestimation or overestimation of abundance [14,15]. However, some of these techniques are limited to use with large or easily detected species that occur across small geographic ranges or in areas of low habitat complexity [16,17].

A species that requires additional research to provide precision estimates of density is the critically endangered Tasman parakeet (*Cyanoramphus cookii*). This species is a cryptically coloured parrot, which is restricted to a small patch of remnant forest on Norfolk Island (Pacific Ocean) [18–20]. As an island endemic, the Tasman parakeet has suffered significant declines due to habitat loss, predation, and competition with introduced species [20,21]. After a severe population collapse in the early 1980s, a recovery programme was established to prevent the extinction of the species [19,22,23].

The recovery of the Tasman parakeet population has been monitored irregularly using a variety of survey methods since the 1970s. As observed in other parrot species, an unstructured approach to monitoring can severely constrain the ability to compare estimates and reduce the confidence with which population trends can be inferred [24]. In addition, the low density of the population and cryptic colouration of the species have limited the precision of estimates produced by past assessments [22,25]. Therefore, identifying the most efficient and precise method is critical to establishing effective long-term monitoring and is considered a key priority for the Tasman parakeet recovery programme [26].

The primary aim of this study was to identify a reliable and repeatable method for monitoring the critically endangered Tasman parakeet population. Using statistical resampling, we examined the precision of the count estimates obtained by two methods commonly used for monitoring parrot populations: fixed-point counts and line transect counts. The theoretical performance of each method was compared, allowing us to identify the best approach to sampling this cryptically coloured species. This will provide essential information for establishing an effective long-term monitoring strategy for this critically endangered parrot population.

2. Materials and Methods

2.1. Study Site and Data Collection

The Norfolk Island National Park (Norfolk Island; 29.0408° S, 167.9547° E), established in 1984, comprises two main areas of protected habitat: the Mount Pitt section on mainland Norfolk Island and the nearby Phillip Island [22]. Our study was undertaken in the 4.6 km² Mount Pitt region, the only area of the national park that supports a naturally occurring population of the critically endangered Tasman parakeet [19].

We conducted seasonal surveys of the Tasman parakeet population in the autumn, winter, and spring of 2014 and 2015. We obtained data using two methods: fixed-point counts and line transect counts. For both methods, counts were conducted between 06:30 and 12:00, a period of heightened activity established for *Cyanoramphus* parakeets [24]. To increase the probability of detecting parakeets during this time, we only collected data in conditions measuring two or less on the Beaufort wind scale. All counts were conducted by four to six experienced observers to ensure the accuracy of species identification.

In this study, a survey was considered as all samples obtained during a single trip to the study site. A sample was the total number of counts conducted in a single day and may also be referred to as sampling effort. A count was the total number of detections obtained during a single ten-minute period. A detection, as described below, is any positive identification (acoustic or visual) of the Tasman parakeet observed during a single ten-minute count period.

2.1.1. Fixed-Point Method

To conduct fixed-point counts, we used the RAND function in Excel to select a random subset of points from an existing grid of rodent bait stations prior to every survey (Figure 1A), which are distributed across the Mount Pitt section of the Norfolk Island National Park (Supplementary Figure S1). These points cover a variety of habitat types

within the area occupied by the Tasman parakeet. Consequently, the distance, terrain, and habitat separating each of these randomly selected points varied, which limited the number of counts conducted during each day.

To increase the likelihood of detecting parakeets and minimise disturbance to our study species, we approached each point as quietly as possible. After arriving at each point, a five-minute rest period was observed before beginning the count, further mitigating the effects of any disturbance caused by the approaching observer. During each count, we observed for ten minutes, recording any acoustic or visual parakeet detections for later analysis. Acoustic detections consisted of Tasman parakeet vocalisation heard near the point. During counts, any calls that could not accurately be assigned to our study species or those that were judged to be repeats of those already heard were not recorded to reduce the likelihood of counting the same individual, pair, or group more than once. Visual detections consisted of any positively identified individual, pair, or group of Tasman parakeets observed from the survey point from 1 to 100 m in clear view.

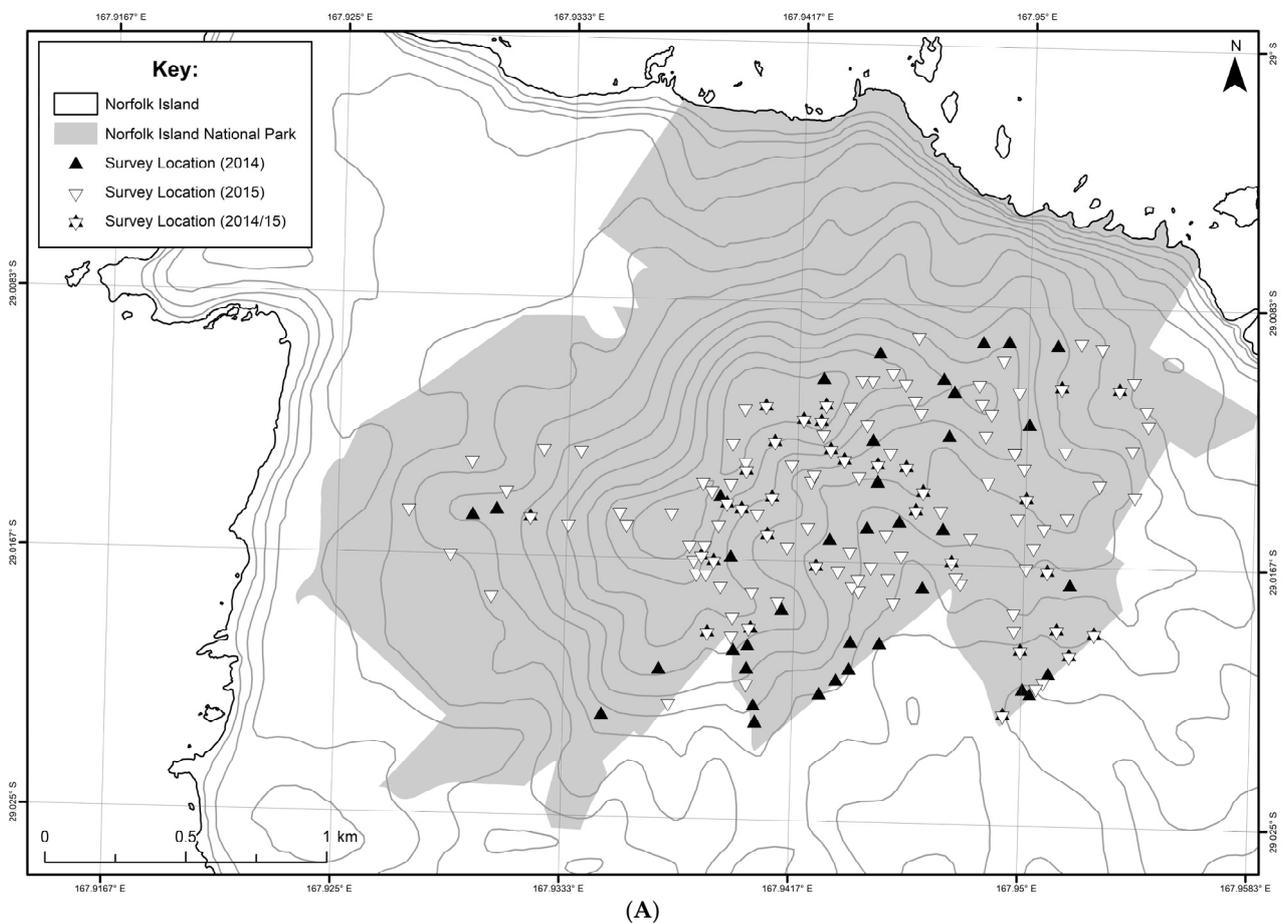


Figure 1. Cont.

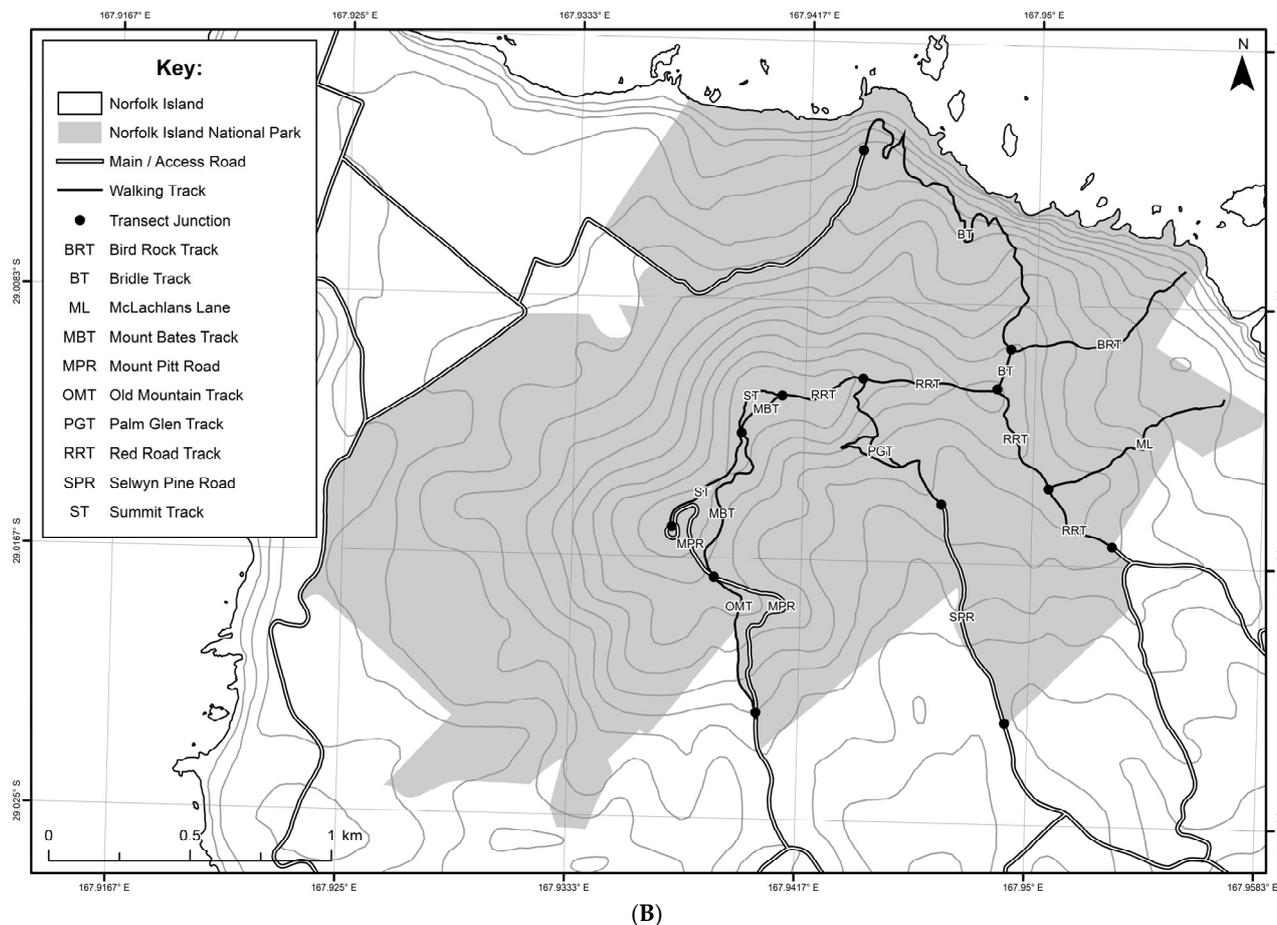


Figure 1. Maps of the Mount Pitt section of the Norfolk Island National Park where we conducted counts of the Tasman parakeet (*Cyanoramphus cookii*). (A) shows the distribution of survey points, and (B) shows the distribution of walking tracks and roads. Dark grey lines show the increase in elevation at 20 m intervals.

2.1.2. Line Transect Method

Line transect counts were conducted along the accessible walking paths, tracks, and roads distributed across the Mount Pitt section of the Norfolk Island National Park (Figure 1B). These tracks and roads covered a variety of habitat types within the occurrence area of the Tasman parakeet. Despite each of these transects varying in length, they were selected in favour of those with randomly selected starting points and a standardised sampling length to better reflect the line transect counts conducted in previous assessments of the Tasman parakeet population. To accurately represent the counts conducted in these previous assessments, we alternated our starting location and direction of travel each day.

During our sampling events, we attempted to cover the entire network of tracks to achieve a representative sample, though this was occasionally limited by the availability of observers. We walked quietly and at a relatively slow pace (2.0–3.5 km/h) to maximise our chance of detecting parakeets. While walking, any acoustic or visual parakeet detections were recorded, along with GPS coordinates for later analysis. Again, an acoustic record was any distinct Tasman parakeet call heard near the transect line. To reduce the possibility of double counting, we excluded all vocalisations from individuals, pairs, or groups of parakeets that had previously been recorded. This approach was practical on site because a calling parakeet or group can be “followed”: based on the timing and direction of calls, observers can distinguish between individuals or groups. Only unique individuals, pairs, or groups of Tasman parakeets that were clearly identified along the transect line were included as visual detections. During our data collection, we were not able to individually

identify Tasman parakeets. Encounters with individually recognisable Tasman parakeets are rare to date. In a recent study conducted from 2020 to 2023, it was estimated that only approximately 18% of the Tasman parakeet population has been banded [27] and can therefore be individually identified. Although our data collection happened prior to the Gautschi et al. study [27], we consider that the proportion of banded Tasman parakeets that could be identified was possibly higher than 18%, as banding of chicks at the nest only started nine months prior to our study.

2.2. Data Analysis

We used R version 3.3.3 [28] to examine and compare the count data collected during this research. To compare the efficiency of the two field methods, we used a bootstrap resampling approach to produce many comparable, replicated data sets from the original fixed-point count and line transect count data. The sample sizes in the original data sets were unbalanced between the two methods. However, our resampling approach allowed us to standardise the sample sizes between the two methods so they could be compared with equivalence across a range of different surveys. We resampled the data obtained during the winter of 2015 because the sample sizes for each method were relatively even during this period compared to other combinations of season and year: $n = 73$ for fixed-point counts and $n = 105$ for line transect counts.

The bootstrap algorithm was designed to simulate count data collected during a typical research trip. The number of counts taken per day was standardised to ten for both methods, whereas the number of counts per day in the original data varied from four to 15, with means of 9 and 11 counts conducted per day for the fixed-point and line transect methods, respectively. We simulated samples for one, two, three, four, five, six, and seven days (with 10 counts per day). For each day, the bootstrap algorithm proceeded in two steps: first, we took a random sample of the days without replacement from the list of days in the original data; we then took a random sample with replacement of ten counts from within each of the selected days. This process was repeated $m = 1,000,000$ times for each sample, yielding sample sizes of $n = 10, 20, 30, 40, 50, 60,$ and 70 (corresponding to the samples for 1 to 7 days, respectively).

Let x_{ij} represent the j th count from the i th simulated sample, where $i = 1, \dots, m$ and $j = 1, \dots, n$. The mean of each sample was calculated as:

$$\bar{x}_i = \frac{1}{n} \sum_{j=1}^n x_{ij} \quad (1)$$

The mean and standard error of the sample means were given by:

$$\bar{\bar{x}} = \frac{1}{m} \sum_{i=1}^m \bar{x}_i \quad (2)$$

$$SE = \sqrt{\frac{1}{m-1} \sum_{i=1}^m (\bar{x}_i - \bar{\bar{x}})^2} \quad (3)$$

The precision was calculated as:

$$p = SE / \bar{\bar{x}} \quad (4)$$

In addition to the precision of the count means, we used the bootstrap data to examine the cumulative number of parakeet detections obtained during each sample for both methods. Means of the total counts (across the bootstrap samples) were then plotted to visualise the relative efficiency of the two survey methods. Similarly, we plotted the estimated precision of the counts to compare the precision of fixed-point and line transect counts. A summary of the raw data used for these analyses is offered below, within this we define a successful count as any count where the number of detections is greater than zero.

2.3. Raw Data

During the winter of 2015, we spent a total of 88 h in the Mount Pitt section of the Norfolk Island National Park; this included 18.25 h of fixed-point counts and 46.15 h of line transect counts. Collectively, these counts yielded a total of 163 parakeet detections, 62% of which were visual observations, with the remainder being acoustic detections. The fixed-point counts accounted for 59% of all recorded detections. The number of counts that yielded detections varied between the methods, with 46 and 23 successful surveys for the fixed-point survey method and line transect survey method, respectively. This is equivalent to a 63% success rate for fixed-point surveys and a success rate of 22% for the line transect surveys.

3. Results

Although both survey methods were successful at detecting Tasman parakeets in the field, the precision of the mean detections per count varied with each method and the sampling effort (Figure 2). The results of the bootstrap resampling analysis indicate the line transect method was less precise than the fixed-point method, with a mean precision of 0.476 and 0.274, respectively. Increasing the sampling effort improved the precision of the estimates produced by each count type (Figure 2).

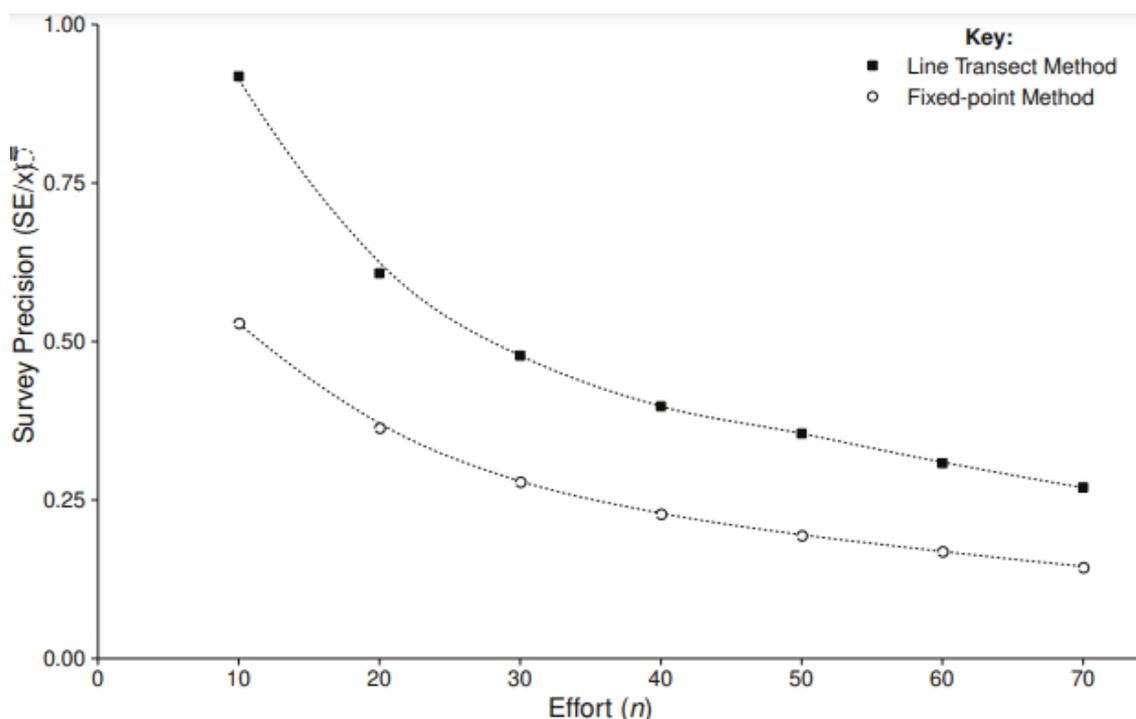


Figure 2. Precision of estimates from the bootstrap analysis of data obtained by two methods used to monitor the Tasman Parakeet (*Cyanoramphus cookii*) population in the Mount Pitt section of the Norfolk Island National Park.

Following an initial sample of ten counts, the precision (standard error/mean) of the line transect method was estimated as 0.918, and for fixed-point counts, it was 0.530. Following a further 60 counts, the precision of estimates improved to 0.270 and 0.145 for line transect counts and fixed-point counts, respectively. The fixed-point method produced greater precision, where approximately 30 fixed-point counts were required to give the same precision as 70 line transect counts.

The fixed-point method also produced greater cumulative detections than the line transects method (Figure 3). Assuming that the number of Tasman parakeet detections was proportional to sampling effort, the fixed-point method was estimated to produce a

mean of 1.338 parakeet detections per count (95% CI: 0.649, 2.048). In contrast, the line transect method only produced a mean of 0.642 parakeet detections per count (95% CI: 0.174, 1.370). These results indicate that fixed-point counts can obtain the same number of parakeet detections as 70 line transects in as few as 34 counts.

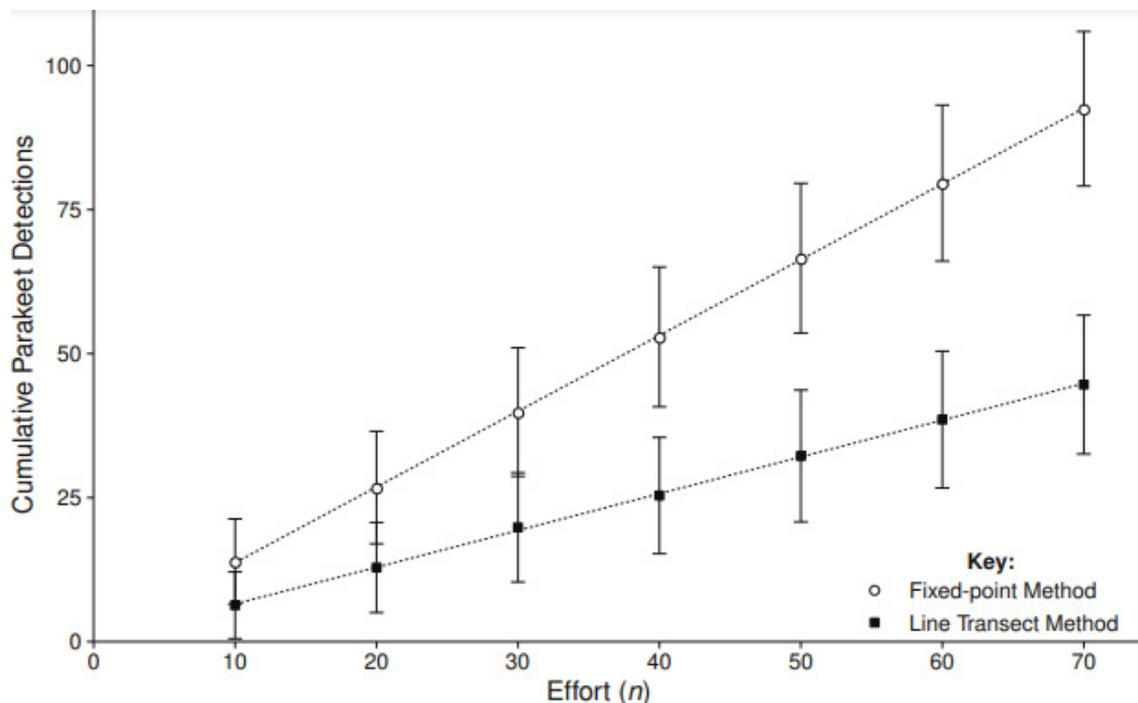


Figure 3. Cumulative detections from the bootstrap analysis of data obtained by two methods used to monitor the Tasman Parakeet (*Cyanoramphus cookii*) population in the Mount Pitt section of the Norfolk Island National Park.

4. Discussion

Our results indicate that fixed-point counts were the most suitable method for monitoring the Tasman parakeet population on Norfolk Island. Fixed-point counts yielded a higher number of detections per unit of sampling effort compared to line transect counts (Figure 3). This is despite the fact that, during fixed-point counts, birds detected while walking between points are not able to be included in analysis, whereas during line transect counts, sampling occurs while walking, so most detections are recorded [29,30]. Despite this, the fixed-point method outperformed the line transect method and accounted for 59% of Tasman parakeet detections recorded in the winter of 2015. One possible explanation for the poor performance of line transect counts on Norfolk Island is the use of paths, roads, and tracks rather than randomly selected transect lines. In New Caledonia, Legault et al. [31] noted that most parrot species exhibit a preference for forests and generally avoid forest edge areas. When conducting counts, these preferences may bias downwards the number of detections, particularly if there is a lack of vegetation near the transect line [24].

Fixed-point counts were also more precise than line transect counts. To achieve a similar level of precision to these fixed-point counts, a far larger sampling effort was required for line transect counts (Figure 2). Other studies suggest that fixed-point counts can result in biased estimates [32–34]. However, compared to line transect counts, accurately recording multiple detections is considered more straightforward for observers conducting fixed-point counts [29]. Furthermore, differences in the walking speed of observers may contribute to detection bias between sampling events, particularly when attempting to detect cryptically coloured species such as the Tasman parakeet.

Our results contrast with a study of parrots in New Caledonia, in which Legault et al. [24] determined that the line transect method was more efficient than the fixed-point

method. Their assessment involved monitoring a variety of cryptic parrot species, including the New Caledonian parakeet (*Cyanoramphus saisseti*), a medium-sized parrot that is closely related to the Tasman parakeet [35]. Their findings provide insight into the value of line transect counts for monitoring parrots across large areas of habitat, where scalability is an issue for fixed-point counts. When compared to the 4.6 km² area of remnant habitat that the Tasman parakeet occupies on Norfolk Island, the areas surveyed by Legault et al. [24,31] were considerably larger, ranging between 45 km² and 130 km². The benefits of conducting rapid line transect counts through habitats of low complexity are likely to be negligible for monitoring parrots on Norfolk Island. Additionally, the limitation of scalability is minimised on Norfolk Island, as the area of remnant forest is relatively small and consists of a mixture of habitat types, many of which can be accessed with minimal effort. Thus, it is likely that the size of the area and the type of habitats to be surveyed are important factors in the relative utility of these two methods, and these factors should be taken into account when designing monitoring studies.

In conclusion, we encourage the use of the fixed-point survey method for monitoring the Tasman parakeet population on Norfolk Island, as it offers greater precision and efficiency per unit of effort. While this is the case as the population is recovering, regular assessment of the most suitable survey method may be useful as the density of the parakeet population changes. Future data collected using this standardised method of sampling will likely provide greater power to evaluate the future status and trends in the population of this species, compared to the more sporadic, unstructured monitoring that has occurred over the past four decades. However, we acknowledge that other factors not evaluated here, such as financial resources available, accessibility of terrain, dispersal of birds outside the core management area, etc., could also play a role in selecting the most appropriate survey methodology. The findings of this study also give an indication of the suitability of this method for monitoring other cryptic species that occupy small areas of habitat and may be useful for other researchers investigating species with restricted distributions.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/d16110698/s1>, Figure S1: Maps of the Mount Pitt section of the Norfolk Island National Park where we conducted counts of the Tasman parakeet (*Cyanoramphus cookii*) showing the distribution of rodent bait stations. Dark grey lines show the increase in elevation at 20 m intervals.

Author Contributions: Conceptualization, L.O.-C. and M.J.A.S.; methodology, L.O.-C. and M.J.A.S.; software, M.J.A.S. and A.N.H.S.; validation, M.J.A.S. and A.N.H.S.; formal analysis, M.J.A.S. and A.N.H.S.; investigation, L.O.-C. and M.J.A.S.; resources, L.O.-C. and A.N.H.S.; data curation, M.J.A.S.; writing—original draft preparation, M.J.A.S.; writing—review and editing, M.J.A.S., A.N.H.S. and L.O.-C.; visualization, M.J.A.S.; supervision, L.O.-C. and A.N.H.S.; project administration, L.O.-C.; funding acquisition, L.O.-C. and M.J.A.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by The Mohamed bin Zayed Species Conservation Fund, grant number (142510085), Disney Wildlife Conservation Fund, Institute of Natural and Mathematical Science—Massey University, Wild Mob, the Nature Conservancy, Island Conservation, BirdLife Australia, the Parrot Society UK, and the World Parrot Trust.

Institutional Review Board Statement: The field data collected here was authorised by the Australian Government/Director of National Parks under collaborative agreement number 3000027307 between the Director of National Parks and Massey University.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: We thank The Department of the Environment Australia and the staff from the Norfolk Island National Park: Joel Christian, Ken Christian, Craig Doolan, Dids Evans, Cassandra Jones, Matt King, Rosco Quintal, Abigail Smith, and Melinda Wilson. We also thank the numerous volunteers who assisted with data collection: Tansy Bliss, Rebecca Hamner, Luke Martin, Serena Simmonds, John Steemson, Nat Sullivan, Matt Upton, Amy Waldmann, Daniel Waldmann, Emma

Wells, and Liz Whitwell. Logistical support was provided by Norfolk Island National Park and the Norfolk Island Flora and Fauna Society.

Conflicts of Interest: The authors declare no conflicts of interest.

References

- Kellner, K.F.; Swihart, R.K. Accounting for imperfect detection in ecology: A quantitative review. *PLoS ONE* **2014**, *9*, e111436. [[CrossRef](#)] [[PubMed](#)]
- Silveira, L.; Jacomo, A.T.; Diniz-Filho, J.A.F. Camera trap, line transect census and track surveys: A comparative evaluation. *Biol. Conserv.* **2003**, *114*, 351–355. [[CrossRef](#)]
- Dénes, F.V.; Tella, J.L.; Beissinger, S.R. Revisiting methods for estimating parrot abundance and population size. *Emu* **2018**, *118*, 67–79. [[CrossRef](#)]
- Kéry, M.; Dorazio, R.M.; Soldaat, L.; van Strien, A.; Zuiderwijk, A.; Royle, J.A. Trend estimation in populations with imperfect detection. *J. Appl. Ecol.* **2009**, *46*, 1163–1172. [[CrossRef](#)]
- Marsden, S.J.; Royle, K. Abundance and abundance change in the world's parrots. *Ibis* **2015**, *157*, 219–229. [[CrossRef](#)]
- Boulinier, T.; Nichols, J.D.; Sauer, J.R.; Hines, J.E.; Pollock, K.H. Estimating species richness: The importance of heterogeneity in species detectability. *Ecology* **1998**, *79*, 1018–1028. [[CrossRef](#)]
- Williams, B.K.; Nichols, J.D.; Conroy, M.J. Estimating abundance based on counts. In *Analysis and Management of Animal Populations: Modelling, Estimation and Decision Making*; Academic Press: London, UK, 2002; pp. 241–262.
- MacKenzie, D.I.; Nichols, J.; Sutton, N.; Kawanishi, K.; Bailey, L.L. Improving inference in population studies of rare species that are detected imperfectly. *Ecology* **2005**, *86*, 1101–1113. [[CrossRef](#)]
- Pollock, K.H.; Nichols, J.D.; Simons, T.R.; Farnsworth, G.L.; Bailey, L.L.; Sauer, J.R. Large scale wildlife monitoring studies: Statistical methods for design and analysis. *Environmetrics* **2002**, *13*, 105–119. [[CrossRef](#)]
- Ahrestani, F.S.; Hebblewhite, M.; Post, E. The importance of observation versus process error in analyses of global ungulate populations. *Sci. Rep.* **2013**, *3*, 3125. [[CrossRef](#)]
- Anderson, D.R. The need to get the basics right in wildlife field studies. *Wildl. Soc. Bull.* **2001**, *29*, 1294–1297.
- Hodgson, J.C.; Baylis, S.M.; Mott, R.; Herrod, A.; Clarke, R.H. Precision wildlife monitoring using unmanned aerial vehicles. *Sci. Rep.* **2016**, *6*, 22574. [[CrossRef](#)] [[PubMed](#)]
- Hodgson, J.C.; Mott, R.; Baylis, S.M.; Pham, T.T.; Wotherspoon, S.; Kilpatrick, A.D.; Raja Segaran, R.; Reid, I.; Terauds, A.; Koh, L.P. Drones count wildlife more accurately and precisely than humans. *Methods Ecol. Evol.* **2018**, *9*, 1160–1167. [[CrossRef](#)]
- Harvey, E.; Fletcher, D.; Shortis, M.R.; Kendrick, G.A. A comparison of underwater visual distance estimates made by scuba divers and a stereo-video system: Implications for underwater visual census of reef fish abundance. *Mar. Freshw. Res.* **2004**, *55*, 573–580. [[CrossRef](#)]
- Salinas-de-León, P.; Acuña-Marrero, D.; Rastoin, E.; Friedlander, A.M.; Donovan, M.K.; Sala, E. Largest global shark biomass found in the northern Galápagos Islands of Darwin and Wolf. *Peer J.* **2016**, *4*, e1911. [[CrossRef](#)]
- Anderson, K.; Gaston, K.J. Lightweight unmanned aerial vehicles will revolutionize spatial ecology. *Front. Ecol. Environ.* **2013**, *11*, 138–146. [[CrossRef](#)]
- Linchant, J.; Lisein, J.; Semeki, J.; Lejeune, P.; Vermeulen, C. Are unmanned aircraft systems (UASs) the future of wildlife monitoring? A review of accomplishments and challenges. *Mammal Rev.* **2015**, *45*, 239–252. [[CrossRef](#)]
- Forshaw, J.M. *Australian Parrots*, 3rd Revised ed.; Alexander Editions: Queensland, Australia, 2002.
- Hill, R. *Recovery Plan for the Norfolk Island Green Parrot Cyanoramphus novaehollandiae Cookii*; Environment Australia: Canberra, Australia, 2002.
- Taylor, R.H. Status, habits and conservation of *Cyanoramphus* parakeets in the New Zealand region. In *Conservation of Island Birds: Case Studies for the Management of Threatened Island Species*; Moors, P.J., Ed.; International Council for Bird Preservation: Cambridge, UK, 1985; pp. 195–211.
- Director of National Parks. *Norfolk Island Region Threatened Species Recovery Plan*; Department of the Environment, Water, Heritage and the Arts: Canberra, Australia, 2010.
- Director of National Parks. *Norfolk Island National Park and Norfolk Island Botanic Garden Management Plan 2008–2018*; Australian Government: Canberra, Australia, 2008.
- Hicks, J.; Greenwood, D. Rescuing Norfolk Island's parrot. *Birds Int.* **1989**, *1*, 34–47.
- Legault, A.; Theuerkauf, J.; Baby, E.; Moutin, L.; Rouys, S.; Saoumoé, M.; Verfaille, L.; Barré, N.; Chartendraut, V.; Gula, R. Standardising distance sampling surveys of parrots in New Caledonia. *J. Ornithol.* **2013**, *154*, 19–33. [[CrossRef](#)]
- Dutson, G. Population densities and conservation status of Norfolk Island forest birds. *Bird Conserv. Int.* **2013**, *23*, 271–282. [[CrossRef](#)]
- Ortiz-Catedral, L.; Nias, R.; Fitzsimons, J.; Vine, S.; Christian, M. Back from the brink—Again: The decline and recovery of the Norfolk Island Green Parrot. In *Recovering Australian Threatened Species*; Garnett, S., Latch, P., Lindenmayer, D., Woinarski, J., Eds.; CSIRO Publishing: Clayton South, Australia, 2018; pp. 105–114.

27. Gautschi, D.; Stojanovic, D.; MacGregor, N.A.; Ortiz-Catedral, L.; Wilson, M.; Olsen, P.; Crates, R.; Heinsohn, R. Stochastic population models hindcast population trajectory and breeding history of an endangered parrot. *Emu—Austral Ornithol.* **2023**, *123*, 335–344. [[CrossRef](#)]
28. R Core Team. *R: A Language and Environment for Statistical Computing*; R Foundation for Statistical Computing: Vienna, Austria, 2017.
29. Buckland, S.T.; Marsden, S.J.; Green, R.E. Estimating bird abundance: Making methods work. *Bird Conserv. Int.* **2008**, *18*, S91–S108. [[CrossRef](#)]
30. Thomas, L.; Buckland, S.T.; Burnham, K.P.; Anderson, D.R.; Laake, J.L.; Borchers, D.L.; Strindberg, S. Distance sampling. In *Encyclopedia of Environmetrics*; El-Shaarawi, A.H., Piegorsch, W.W., Eds.; Wiley: Chichester, UK, 2002; pp. 544–552.
31. Legault, A.; Theuerkauf, J.; Rouys, S.; Chartendrault, V.; Barré, N. Temporal variation in flock size and habitat use of parrots in New Caledonia. *Condor* **2012**, *114*, 552–563.
32. Buckland, S.T.; Anderson, D.R.; Burnham, K.P.; Laake, J.L.; Borchers, D.L.; Thomas, L. *Introduction to Distance Sampling: Estimating Abundance of Biological Populations*; Oxford University Press: Oxford, UK, 2001.
33. Casagrande, D.G.; Beissinger, S.R. Evaluation of four methods for estimating parrot population size. *Condor* **1997**, *99*, 445–457. [[CrossRef](#)]
34. Cassey, P.; Craig, J.L.; McArdle, B.H.; Barraclough, R.K. Distance sampling techniques compared for a New Zealand endemic passerine (*Philesturnus carunculatus rufusater*). *N. Zeal. J. Ecol.* **2007**, *31*, 223–231.
35. Boon, W.M.; Daugherty, C.H.; Chambers, G.K. The Norfolk Island Green Parrot and New Caledonian Red-crowned Parakeet are distinct species. *Emu* **2001**, *101*, 113–121. [[CrossRef](#)]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.