STATUS OF THE ORANGE-FRONTED PARAKEET/KĀKĀRIKI KARAKA POPULATION IN THE SOUTH BRANCH OF THE HURUNUI

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PURPOSE

Recent estimates suggest that the population of Orange-fronted Parakeets (or OFPs) in the South Branch of the Hurunui has experienced a severe decline. In 2020/21, the population was estimated to comprise 221 (186-256) birds, yet this has fallen to approximately 107 (89-125) birds in 2021/22. Given the implications of these results, the aim of this memo is to provide some background on the methods used to generate these estimates, to describe the assumptions and caveats associated with these methods, to provide additional evidence supporting these findings, and to suggest actions that can be taken to better understand the causes of the observed decline.

BACKGROUND

Early attempts to estimate the size of the Orange-fronted Parakeet population were fraught with difficulty. Encounter rates were abandoned as they provided only an index of abundance, and were of limited use in understanding the true size of the population. Distance sampling returned imprecise estimates because of the limited number of Orange-fronted Parakeets available to survey, and the presence of Yellow-crowned Parakeets complicated matters further. Achieving reliable and representative results with distance sampling also required a considerable amount of time and effort. As a result of these obstacles, the recovery group collectively decided to discontinue distance sampling in 2016/17.

It is only in the last few years that we have had the ability to monitor the size of the Orange-fronted Parakeet population in the South Branch of the Hurunui with a reasonable degree of confidence. This breakthrough was made possible by banding parakeets, both prior to their release and as nestlings in the wild. Doing so has allowed us to conduct mark-resight surveys, which provide an effective means of estimating the absolute number of birds in a population.

The fundamental premise of mark-resight analysis is that the size of a population can be estimated if we know a) the number of banded birds present, and b) the number of sightings of banded and unbanded birds. The simplest form of this type of analysis is represented by the following equation, known as the Lincoln-Petersen estimator:

$$N = \frac{m_1 n_2}{m_2}$$

where N is the size of the population, m_1 is the number of banded birds, n_2 is the total number of banded and unbanded bird sightings, and m_2 is the number of banded bird sightings.

Unfortunately, the Lincoln-Petersen estimator cannot be used for tracking populations in the South Branch of the Hurunui over extended timeframes because frequent releases create ongoing complications with data analysis. Therefore, a customised method of analysis was developed to generate a rolling estimate of population size. The resulting approach incorporates a modified form of Bowden's estimator, which is similar to the Lincoln-Petersen estimator but relaxes certain assumptions associated with the latter method of analysis, including the need for all sightings of banded birds to be uniquely identified.

ASSUMPTIONS & CAVEATS

It is important to realise that no method of population estimation is perfect. Unless we are conducting a complete census of the population, there will always be some degree of extrapolation and bias involved. Accordingly, there are a few assumptions and caveats involved in generating a rolling population estimate for Orange-fronted Parakeets in the South Branch of the Hurunui:

1) Because we are dealing with a critically endangered species, the estimate is deliberately conservative. In practice, this means that undetected birds are assumed to be dead until proven otherwise. If we are unable to detect certain birds, then it is arguably better to assume that they are dead, at the risk of underestimating the population by a small factor, rather than assume that they are alive, at the risk of overestimating the population by a large factor. If

birds are detected after the survey period is over, then the estimates will be adjusted retrospectively to account for this.

2) The analysis assumes that a year (plus a two-month pre-survey period) is sufficient to detect and identify banded birds in the study area. This timeframe was chosen because earlier analyses revealed that birds very rarely reappear if they have been missing for a year or more. Also, this ensures that the collection period always includes the winter, summer, and shoulder seasons, no matter when the survey starts and ends. If the collection period was only six months, for example, then the survey would be biased low during the winter and high during the summer. On the other hand, a two-year collection period would be far too long, as this would imply that all of the birds detected in the past two years are still alive today.
3) A correction factor has been applied to allow for population estimates to continue while releases are underway. Without this, a rolling population estimate would not be possible. As a result of these corrections, the impact of releasing birds in the wild is spread over time, and is only fully realised if those birds continue to be detected in surveys that commenced after the date of their release.
4) This method was specifically developed to make it possible to track population trends without needing to dedicate additional time to surveys, yet it will only yield reliable estimates if monitoring continues. Banded birds only need to be identified once over the course of a year to be considered alive, but if there hasn't been much effort dedicated to searching for birds or identifying birds from feeder photos, then this could lead to underestimation. It is important to realise, however, that the relationship between effort and population size is non-linear. Accordingly, an increase in effort will only lead to an increase in population size up to a certain threshold (*i.e.* the point at which no new individuals are being identified).
5) All available data are used to determine whether a bird is alive or not, so the importance of feeder data should not be overlooked. Earlier analyses indicated that close to one-third of the banded birds identified in 2018/19 were detected only through feeder surveillance. Recent estimates do not include these data because of a backlog of photos awaiting review. However, this is not a new issue, nor does it only affect the latest estimates. Any birds detected through this process would be included retrospectively, so all estimates generated since the bird went missing would be impacted. Reviewing these photos will help to improve the accuracy of the estimate, but the omission of this information is unlikely to account for the observed decline.

6) Like most methods of population estimation, this approach is prone to sampling bias. For example, if staff are not putting the same amount of effort into documenting sightings of unbanded birds as they do for sightings of banded birds, then the estimate will be biased low.
7) To achieve reliable estimates with mark-resight surveys, a relatively large percentage of the population must be banded (c. 40-75%, depending on the size of the population). This can be achieved by releasing banded birds into the population, or by banding nestlings in the wild. Without these measures, the proportion of banded birds will naturally decline, and mark-resight methods will cease to provide meaningful results.

SUPPORTING EVIDENCE

If the results of the mark-resight analysis are not convincing enough, then a comparison of the raw data over the past two seasons may help to demonstrate why there is cause for concern in the South Branch of the Hurunui.

Only 48 banded Orange-fronted Parakeets were identified during fieldwork in 2021/22, down from 86 banded Orange-fronted Parakeets in 2020/21. This represents a 44% decline in the number of banded Orange-fronted Parakeets being identified from one season to the next.

Similar trends are apparent in the number of parakeet sightings recorded during fieldwork each season:

Season	Sightings			Search effort (hours)
	OFP	YCP	UIP	
2020/21	701	66	187	610
2021/22	333	51	123	588

These results indicate that Orange-fronted Parakeet sightings declined by 52% from 2020/21 to 2021/22, despite only a 4% drop in search effort, based on staff work logs. In 2020/21, searches reportedly covered 10 blocks, with staff spending the most hours in Easy (205), Bong (193), Roche (106), and Foggy (40). In 2021/22, searches covered 14 blocks, with staff spending the most hours in Bong (191), Easy (76), Hut (63), and Indecision (53). If anything, this suggests that search effort was more widely distributed in 2021/22 than 2020/21. However, it would be useful to confirm this by analysing the GPS track logs from the past two seasons.

Differences are also evident in the nests and nesting pairs located each season. In 2020/21, staff located 18 nests, the parents of which comprised 17 banded birds, and (up to) 13 unbanded birds. In 2021/22, staff located 10 nests, the parents of which comprised 10 banded birds, and (up to) 10 unbanded birds. Although the differences in the number of nests may have been influenced by seasonal fluctuations in food availability, this does not adequately explain the differences observed in the breeding pairs. Of the 17 banded birds nesting in 2020/21, only 6 were detected in 2021/22. Furthermore, only 3 of these birds were discovered nesting in 2021/22, even though staff knew where their nests would likely be located.

ACTIONS TO IDENTIFY CONTRIBUTING FACTORS

Although it is important to treat these results with a certain degree of caution, it would be reckless to ignore a potentially serious population decline, especially one that affects the species' mainland stronghold. However, unravelling the factors contributing to this situation will take time. The following actions should help to facilitate this process:

1) Ensure that GPS track logs are uploaded so that search effort can be estimated with greater certainty.
2) Review feeder camera photos to improve accuracy of population estimates and minimise the potential for effort-related bias.
3) Review trunk camera videos to identify periods with elevated numbers of rats, mustelids, cats and possums over the past two seasons.
4) Review monthly trap data and tracking tunnel data to identify periods with elevated numbers of rats and mustelids over the past two seasons.
5) Review live capture trap data to identify periods with elevated numbers of cats over the past two seasons.
6) Conduct more thorough searches next season to increase the accuracy and precision of future population estimates.