



# Trapping method and quota observance are pivotal to population stability in a harvested parrot



Simon Valle<sup>a,b,\*</sup>, Nigel J. Collar<sup>c</sup>, W. Edwin Harris<sup>a</sup>, Stuart J. Marsden<sup>a</sup>

<sup>a</sup> School of Science & the Environment, Manchester Metropolitan University, Chester Street, Manchester M1 5GD, UK

<sup>b</sup> Current address: School of Biological Sciences, Bangor University, Bangor, Gwynedd LL57 2UW, UK

<sup>c</sup> BirdLife International, Pembroke Street, Cambridge, CB2 3QZ, UK

## ARTICLE INFO

### Keywords:

Demographic modelling  
Grey Parrot  
CITES  
Population dynamics  
Wildlife trade  
P.V.A

## ABSTRACT

Wildlife trade is currently regulated mainly in terms of ‘volume’, i.e. the number of individuals taken from the wild or numbers appearing on the market in a given year. To explore the possible effects of other factors such as capture methods, variability in annual harvest, and habitat, we built and validated a demographic model for a closed population of Grey Parrots *Psittacus erithacus* on Príncipe, and ran 50-year simulations for the population under different harvest scenarios. There was a fine line between capture volumes being robustly sustainable (11% harvested) and dramatically unsustainable (15%). Population trajectories were highly sensitive to changes in adult survivorship, such that the inclusion of even a small number of adults among the harvest had a far greater impact than a similar number of juveniles. High annual variation in capture rate (reflecting poor national management of trade) could make the difference between sustainability and non-sustainability if quotas were set around critical harvest volumes. While these patterns may be common to large traded parrots generally, sufficient habitat and secure nest sites exist on Príncipe to render the effects of habitat loss on the island less important than in most other situations. If trade in parrots is to continue sustainably it will require reliable demographic and harvest data and must eliminate instability in quota observance (exceeded quotas are not compensated by shortfalls in other years) and, especially, the indiscriminate capture of adults.

## 1. Introduction

The international trade in live animals and wildlife products is a constituent threat to around one-third of all bird and mammal species (UNEP-WCMC, 2017). Legal trade is estimated to be worth over USD 8 billion a year globally (Zhang et al., 2008), and this figure is likely to double when illegal trade is taken into account (Pires, 2012). Parrots, and especially the larger species, are the most traded wild-caught group of birds (UNEP-WCMC, 2017), and there are serious concerns about the sustainability of current harvest levels in many species (Beissinger and Bucher, 1992a; BirdLife International, 2017a). Such concerns arise not just from the sheer volume of parrots in trade, but also from the birds' poor resilience to overharvesting (Beissinger, 2001; Pain et al., 2006; Wright et al., 2001), inadequate enforcement of trade regulations (Martin et al., 2014), and the paucity of reliable population and demographic data to support harvest models (Marsden and Royle, 2015).

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) allows international trade in a taxon only if the proposed harvest has been scientifically proven to be not detrimental to its survival (Rosser and Haywood, 2002). Ideally, ‘non-

detriment’ findings should be underpinned by a robust demographic model that predicts a population's long-term response to harvest (e.g. Beissinger and Westphal, 1998). Such models have rarely been built for parrots (Beissinger, 2001; Koenig, 2008; Strem and Bouzat, 2012), and indeed for most other traded species. Of course, the reliability of harvest models depends both on the availability of appropriate data to support them, and on how well the interactions of parameters within the model reflect the reality of population dynamics in the wild (Boyce, 1992).

Across the tropics, methods of trapping parrots range from the particular ‘chick-only’ harvest from nest cavities (e.g. Juste, 1996), to indiscriminate mass trapping of individuals of any age class from aggregation sites, usually by means of glue-traps or nets (e.g. Ngenyi, 2002, 2003). Moreover, annual CITES-reported imports/exports from range countries vary considerably (UNEP-WCMC, 2017), reflecting supply, demand, and enforcement/trade management issues. Important questions in relation to demographic modelling of harvested parrot populations therefore are:

1. How sensitive are long-term population trajectories likely to be to

\* Corresponding author at: School of Science & the Environment, Manchester Metropolitan University, Chester Street, Manchester M1 5GD, UK.  
E-mail address: [S.Valle@mmu.ac.uk](mailto:S.Valle@mmu.ac.uk) (S. Valle).

small changes/uncertainties in harvest volume which are inevitable under current trade management?

2. Do different trapping methods affect populations differentially for a given harvest volume?
3. What are the effects of variation in annual harvests on harvest sustainability?
4. What are the compound effects of habitat loss and trapping volume and method on long-term population viability?

To explore these issues, we built and validated a stage-classified female-based demographic model (Caswell, 1989) for a closed (insular) population of Grey Parrots *Psittacus erithacus* (with demographic rates typical of other large parrots) to examine the influence of important trapping-related and habitat change variables on harvest sustainability and, as a broader case study, to investigate the population dynamics of large parrots (mean body mass  $\geq 300$  g).

## 2. Methods

### 2.1. Study area and population

The heavily traded Grey Parrot has suffered a dramatic global decline (Annorbah et al., 2016; BirdLife International, 2017b). As a result, its global conservation status has deteriorated from Near Threatened through Vulnerable to Endangered in just five years (IUCN, 2016), and calls for a ban on its trade have only recently been accepted, albeit not unanimously (CITES, 2017). Nonetheless, the species remains relatively common in some parts of its range (Marsden et al., 2015). One such area is the small (136 km<sup>2</sup>) island of Príncipe (São Tomé and Príncipe, Gulf of Guinea), which hosts a demographically isolated, relatively healthy, and well-studied population (Fahlman, 2002; Juste, 1996; Marsden et al., 2015; Melo, 1998; Valle et al., 2017). Grey Parrots were harvested at an average rate of 600 birds per year from the wild in the 1990s (Juste, 1996; Melo, 1998) until a regional ban on all trade was put in place in 2005 (Valle, 2015). Príncipe is broadly divided into two geographically and climatically distinct regions: a low-lying basalt platform in the north, with hills below 180 m a.s.l. (around 65% of island), and a mountainous region in the south (Jones and Tye, 2006). By the beginning of the twentieth century, the forest in the north had been modified in many places by clear-felling, selective logging and the creation of cocoa, coffee and coconut plantations (Exell, 1973). After the country gained independence (1975) most estates were abandoned and today the north is covered by secondary forest interspersed with some commercial species (e.g. Oil Palm *Elaeis guineensis*). The south, owing to its inaccessibility, remains covered in pristine forest with much floral endemism (Figueiredo et al., 2011).

### 2.2. Model implementation

The development and the implementation of the model were undertaken in R (R Core Team, 2014; see Appendix A and B). Quantifying specific life-history traits in parrots is problematic, mainly owing to the difficulties of marking birds individually and determining their lifespan, but also because they range widely in groups and lack individual territories (Beissinger, 2001). We parameterized our model with data collected from Príncipe (Valle, 2015), from elsewhere in the Grey Parrot's range (i.e. Nigeria: McGowan, 2001), from captive Grey Parrots (Taylor and Parkin, 2008; Young et al., 2012), and from ecologically and morphometrically analogous parrot species (Appendix C). Owing to Príncipe's isolation (> 250 km from the nearest source population), its Grey Parrots can be assumed to experience no immigration or emigration (Jones and Tye, 2006), and therefore to form a closed biological population. We set the finite rate of population increase (growth rate per year: Rockwood, 2006)  $\lambda$  to 1.1, which we calculated using consistently designed pre-breeding population estimates from 2012 (Marsden et al., 2015) and 2014 (Valle et al., 2017), according to the

following formula:

$$\lambda = \sqrt[x]{\frac{N_{t+x}}{N_t}} \quad (1)$$

where  $N_{t+x}$  and  $N_t$  are the number of individuals in the population at two different times separated by  $x$  number of years.

Grey Parrots, like most psittacines, form long-term monogamous pair-bonds (Forshaw, 1989; Seibert, 2006). We assumed all females to breed as long as nest sites were available. In captivity, the age of first successful breeding can vary greatly, depending on husbandry conditions, but the median value (interquartile range) is 7.6 (5.4–9.5) (Young et al., 2012). However, Grey Parrots usually reach sexual maturity between their third and fifth years of age (de Grahl, 1987; Lantermann, 2000), as in other large parrot species (Young et al., 2012). We assumed that the fourth year of age is the threshold of adulthood and that the subadult stage comprises individuals in their second and third years.

Like most large psittacines, Grey Parrots are reported to breed once per year throughout their range (Benson et al., 1988), so in the model we assumed a single annual brood. We collected data on productivity for successful nests (fecundity) from 81 nests on Príncipe, which yielded a mean  $\pm$  SD = 1.94  $\pm$  0.72 chicks per brood (Valle, 2015); since clutch-size is negatively correlated with longevity (Ricklefs, 2000), this is likely to be similar in other equally long-lived large parrot species. Inter-annual variability in productivity on Príncipe was low (Valle, 2015), so we assumed an arbitrary low variance (SD) of 0.1 here. At birth, Grey Parrots have a ratio of 1 female to 1.17 males i.e. 46% ( $n = 3892$ ,  $\chi^2 = 25.01$ ,  $p < 0.001$ : Taylor and Parkin, 2008). This is also the same as that in other large parrots (mean  $\pm$  SD = 46%  $\pm$  5%,  $n = 22$ ; Taylor and Parkin, 2008). Longevity and age-specific survivorship of Grey Parrots in the wild are unknown, and such data are lacking for most parrot species. Since longevity is positively correlated with body mass (Brouwer et al., 2000; Young et al., 2012) and adult survivorship (Lindstedt and Calder, 1976), we used the mean survivorship from three surrogate species whose mean body mass is closest to that of Grey Parrots ( $\leq 60$  g difference: Western Corella *Cacatua pastinator*, Major Mitchell's Cockatoo *C. leadbeateri* and Glossy Black-cockatoo *Calyptorhynchus lathami*) involving only comparable data (e.g. del Hoyo et al., 2017) and for which data on both first year and adult survivorship were available. Thus, we assumed that (a) survivorship ( $\pm$  SD) is 52%  $\pm$  0.8% for the first year of life, and 91%  $\pm$  0.3% for birds older than one year; (b) subadults, as fully formed and independent individuals, exhibit the same survivorship as adults (Appendix C); (c) nest success (i.e. at least one chick fledged) rate is 77%, based on all relevant and available literature on parrots (i.e. the mean percentage nest success rate weighted by the number of nest years: see Appendix C); and (d) nest site availability limits the annual number of reproductive pairs (Beissinger and Bucher, 1992b). We inferred the maximum number of available nest sites, i.e. 5502  $\pm$  2132, from the mean minimum density of nests (SD) for primary and secondary forest estimated on Príncipe, i.e. 72  $\pm$  26, and 17  $\pm$  8 nests km<sup>-2</sup> respectively (Valle, 2015), and used a theta-logistic model to simulate nest site availability (see Appendix A).

A factor likely to influence population growth and carrying capacity is food availability. This parameter is difficult to quantify and predict because it is heavily dependent on fine habitat characteristics (e.g. floristic composition and plantation quality), intra- and inter-annual climate variability, and the ability of Grey Parrots to adapt to them. However, since the focus of the analysis is to inform management of small and declining populations where intraspecific competition for food is not a limiting factor, we set no further carrying capacity to the model other than nest site availability.

In captivity, parrot lifespans vary greatly with the conditions in which the birds are kept (in Grey Parrot: median = 8.2 years, IQR = 5.8–12.2, maximum = 48,  $n = 1979$ : Young et al., 2012). There are virtually no data on wild parrot mortality, so we assumed an

Download English Version:

<https://daneshyari.com/en/article/8847628>

Download Persian Version:

<https://daneshyari.com/article/8847628>

[Daneshyari.com](https://daneshyari.com)