Chancellor, R. D. & B.-U. Meyburg eds. 2004
Raptors Worldwide
WWGBP/MME

Preliminary Population Viability Analyses for Oriental White-Backed Vulture *Gyps bengalensis* in Punjab province, Pakistan

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INTRODUCTION

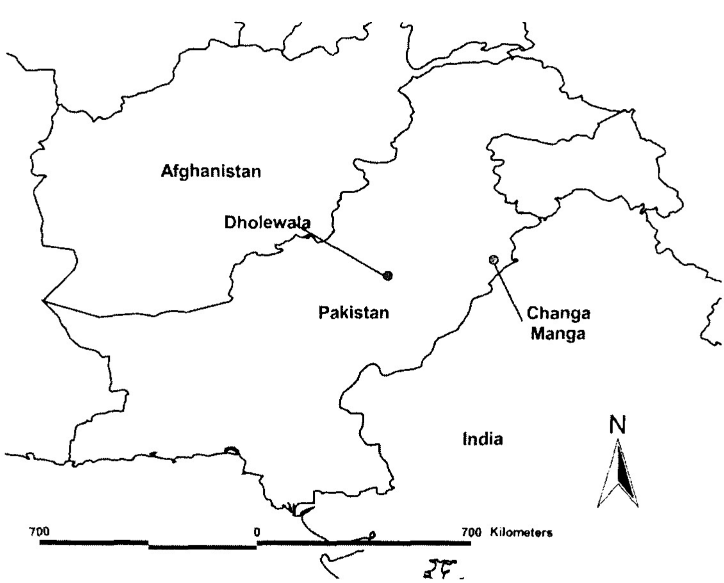
Populations of three species of *Gyps* vultures in South Asia - *Gyps bengalensis*, *G. indicus* and *G. tenuirostris* - have declined precipitously over the last 10 years (Gilbert *et al.* 2002; Pain *et al.* 2003; Prakash *et al.* 2003). Unusually high gout-related vulture mortalities have been recorded in India and Pakistan leading to large-scale population declines throughout the Indian subcontinent (Gilbert *et al.* 2002; Prakash *et al.* 2003; Oaks *et al.* 2004). In Pakistan's Punjab Province, Gilbert *et al.* (these proceedings) have documented population declines between 34% and 95% in breeding Oriental White-backed Vultures *G. bengalensis* colonies over a three-year period (2000 to 2003). Data on population declines in breeding colonies of Indian Long-billed *G. indicus* and Slender-billed Vultures *G. tenuirostris* are lacking, although numbers of birds have declined, based on repeated road-side surveys (Prakash *et al.* 2003).

This paper aims to provide an analytical perspective of the consequences of the drastic decline of populations of Oriental White-backed Vultures (OWBV) in the Punjab Province of Pakistan. We simulated a preliminary population viability analysis (PVA, Beissinger & McCullough 2002; Morris & Doak 2002) for the total population of OWBV in Pakistan as well as for two breeding populations in Dholewala and Changa Manga based on available preliminary demographic estimates. PVAs provide a useful assessment of the importance of various threats to wild populations. This is because, whatever the nature of these threats, they necessarily act through survival, breeding or dispersal. Both deterministic and stochastic modelling approaches were used. They allowed us to discuss the accuracy of available parameters and to build up scenarios for the close future. In this paper we present very preliminary results that should be considered as projections rather than definitive predictions (Peterson *et al.* 2003).

MATERIAL AND METHODS

Demographic data were available for both seasons 2000-2001 and 2001-2002 (Gilbert *et al.* in prep.). These included information on breeding success obtained from intensive surveys of nests at Dholewala and Changa Manga (Figure 1). In the absence of a ringing programme, an index of survival rates was obtained from the ratio of dead adult vultures recovered over the number of breeding pairs at the beginning of the breeding season (Gilbert *et al.* 2002). A deterministic matrix model of the OWBV female life cycle was established based on these parameters. It provided estimates of asymptotic growth rates λ, as well as other life cycle properties (Caswell 2001) for both Dholewala and Changa Manga populations. Second, we used a stochastic two-sex model including demographic stochasticity. Indeed monogamous species may be highly sensitive to demographic stochasticity in sex ratio (Legendre *et al.* 1999). We considered that both sexes had the same demographic parameters and primary sex ratio was 1:1. As a first step, environmental stochasticity and genetics were not considered. For the Pakistan population we considered a total of 15000 birds distributed in all age classes. This estimate was based on the known number of active nests at colonies studies during the 2000/01 season extrapolated over the whole Province, and may reflect an overestimate of the true situation at that time. For Dholewala and Changa Manga we started from a number of 421 and 198 nests respectively according to field data collected in 2000-2001. Mean population sizes, probability and mean time of extinction were obtained after 1000 simulations (montecarlo process) over a 20 year projection period. Models were run using ULM software (Legendre & Clobert 1995; Ferrière *et al.* 1996).

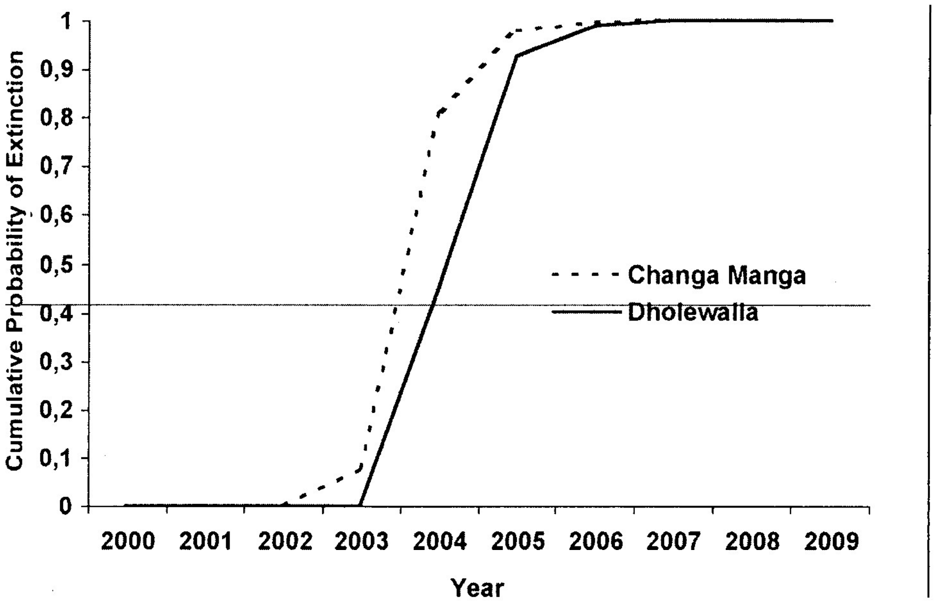
Figure 1. Map of the study areas.



RESULTS AND DISCUSSION

Using the parameters estimated for the first season (2000-2001), both Dholewala and Changa Manga simulated populations were quickly decreasing at rates of more than 9 and 18% p.a. respectively. However, this was clearly optimistic since this the number of nesting pairs fell to 337 and 49 in these two sites at the beginning of 2001-2002. Similarly, when using the parameters estimated on the 2001-2002 season, a strong overestimate of 2002 breeding pair numbers (31 and 9 pairs respectively in the field) was observed. According to the fact that breeding success was likely to be accurately estimated, it appeared that local survival, and particularly adult survival, was likely to be the weak point of this monitoring. A correction factor of adult survival was thus searched for to fit the observed dynamics. In Dholewala, it was necessary to reduce the observed adult survival by 10% in the first season and 80% in the second one to mimic the dramatic decline observed there. In Changa Manga a reduction of observed adult survival by 70% for each season allowed us to reach the observed pattern. These low local survival rates might have been partly due to some dispersal. However in this first approach it was conservative to not consider this possibility. Using the new values corrected in this way, the viability of these populations could be examined. According to these extremely low local survival rates, it appeared that Dholewala and Changa Manga should go extinct within the next 2 to 3 years (Figure 2). On a larger scale, if the total population of OWBV in Pakistan presented the same demographic rates as any of these two populations, it would go also extinct in almost the same time scale (Figure 3).

Figure 2. Cumulative probabilities of extinction for Dholewala and a subset of Changa Manga populations of Oriental White Backed Vulture in Punjab Province Pakistan. See text for simulation parameters.



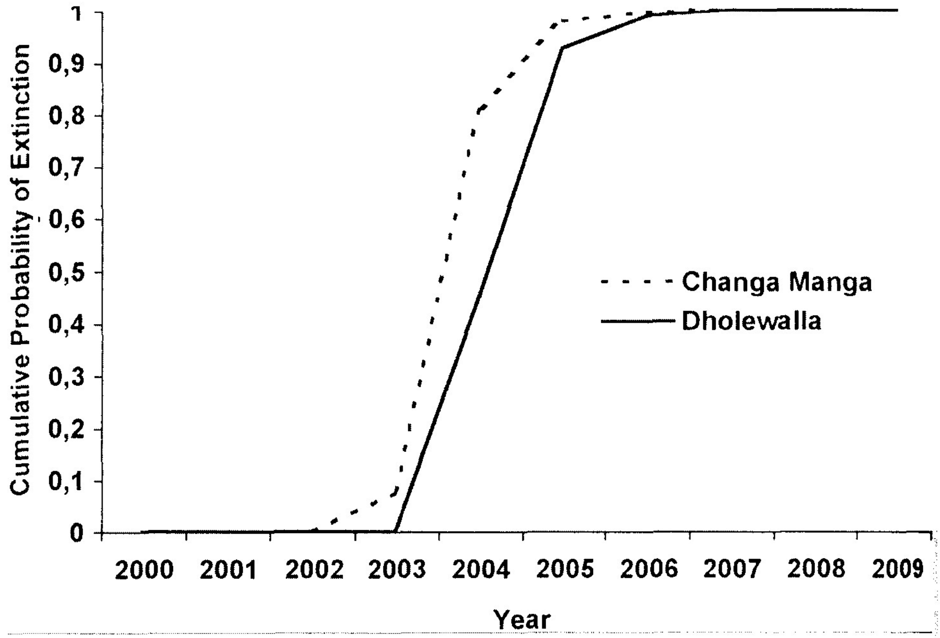
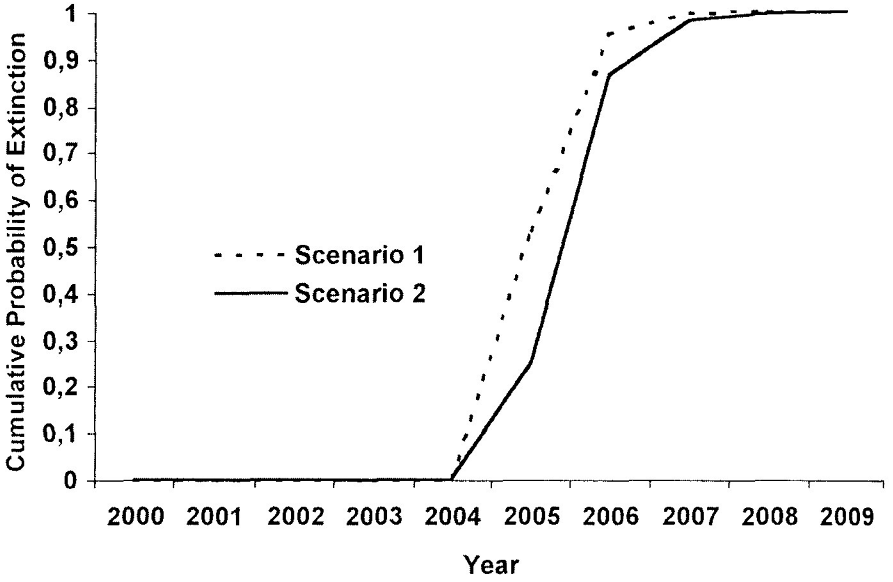


Figure 3. Cumulative probabilities of extinction for the total population of Oriental White Backed Vulture in Pakistan according to two scenarios. Scenario 1: parameters similar to those estimated in Changa Manga. Scenario 2: parameters similar to those estimated in Dholewala.



In conclusion, these preliminary analyses emphasize the dramatic decline of populations of OWBV in Pakistan and demonstrate the need to identify and understand the cause of unusually high vulture mortalities so that remedial measures can be taken to prevent extinction. It is important to emphasize that our results are only a preliminary projection and should not be taken as definitive values and predictions. However, the magnitude of the extinction risk is huge, and immediate conservation action is clearly needed. Furthermore, the great discrepancy between observed local survival and parameters likely to explain these patterns, should underline the difficulty of getting accurate estimates of survival without capture-mark-resighting protocol. Since the population growth rate of such long-lived species is firstly sensitive to adult survival (Ferrière *et al.* 1996; Sarrazin 1998) and because this parameter appeared to be extremely low in these populations, it needs to be accurately estimated to assess the future efficiency of any restoration strategy of populations of OWBV. It is also important to collect long-term breeding and survival data for other species of *Gyps* vultures that have collapsed and where data are lacking.

ACKNOWLEDGEMENTS

This study was funded by The Peregrine Fund through grants obtained from the Betty and Grodon Moore Foundation. We would like to thank our partners in Pakistan, the National Council for the Conservation of Wildlife, the Punjab Department of Wildlife and Bahauddin Zakariya University, Multan. We are grateful to our field staff Jamshed Chaudhary, Shakeel Ahmed, Muhammad Arshad, Shahid Mahmood, Amhad Ali, Ramzan and Muhammad Asim.

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