

# Population structure, migratory connectivity and inference on gene exchange mechanisms in the Asian Houbara Bustard *Chlamydotis macqueenii*: a summary of recent findings

Olivier Combreau, Samuel Riou, Jacky Judas, Mark Lawrence

**Abstract.** The phylogeographic structure of Asian Houbara revealed by genetic analysis suggests some level of differentiation between south and east Arabian resident populations, Sinai populations and the main bulk of Central Asian migrant and resident populations. Satellite tracking in southernmost populations failed to reveal population exchange with northern population and explains partly the genetic structure observed. Although central Asian birds show population specific migratory patterns and strong philopatry, possibilities of dissemination of genetic material between migrant populations and between migrants and residents exist in year-old birds and in adult birds during migration and could contribute to explain the absence of genetic differentiation between Central Asian populations.

**Key words.** Phylogeographic structure, satellite tracking, Macqueen's Bustard, phylopatry.

The identification of biologically relevant management units is critical to the design of an appropriate conservation strategy for the Asian Houbara Bustard *Chlamydotis macqueenii* at a time when large-scale conservation projects are put in place. A population genetic study using samples collected from throughout the range of the Asian Houbara has revealed a phylogeographic structure suggesting the existence of three separate groups: a Central Asian group of migrants and residents closely related to a resident population from Egypt-Sinai, and a third, relatively differentiated resident population from Yemen (RIOU et al., in prep). This indicates some level of genetic isolation of southernmost populations and gene flow among Central Asian populations. Population genetic analysis suggests that the ancestral form of the houbara is the North African species *C. u. undulata*, that can currently be considered a single Conservation Unit (LESOBRE et al. 2010a), and that the colonization of the Arabian Peninsula and differentiation of *C. macqueenii* occurred from 32.8 to 36.1 thousand years ago (PITRA et al. 2004). More recently, at the end of the last glacial period, Asian Houbara may have colonized advancing steppes and arid lands towards the north and developed migratory behaviour (RIOU et al., in prep).

Using satellite tracking techniques (92 adults and 21 juveniles) we evaluated the resident or migratory character of Asian Houbara, the extent of migratory connectivity between populations, natal dispersal, and fidelity to breeding sites in order to identify the possible mechanisms underlying exchanges of genetic material between populations. Residency was confirmed in all of the 11 individual south-eastern Arabian Houbara that were tagged, with



Fig. 1. Asian Houbara Bustard *Chlamydotis macqueenii* with attached satellite transmitter.

The Rub-Al-Khali acting as a barrier with more northern populations. In Asia, we showed substantial partitioning in migration routes and wintering grounds among populations (COMBREAUX et al., in prep). Without exception, all migrant birds followed by satellite tracking returned to within 100 km of their previous breeding site ( $n=71$ ). This strong breeding site fidelity suggests that exchange of genes between populations via adult birds will be limited. Satellite tracking of juveniles from Junggar Basin and from central Kazakhstan indicated heritability of both the migratory distances flown and migration routes. Of the two Chinese juveniles that could be tracked for a minimum of two successive years, one showed philopatry from the first year whereas the other one spent its first breeding season within the range of a shorter migrant population in Uzbekistan, at a distance exceeding 2,000 km from its point of origin, and flew to its birthplace in subsequent years. One year-old houbara commonly show breeding activity in captivity suggesting the possibility of dissemination of long-migrant genes within shorter migrant Central Asian populations by young adults.

The possibility of breeding en route by both adult males and females was investigated in satellite-tracked long-distance migrant adults returning to their breeding grounds and crossing the range of shorter-distance migrants that may already occupy their breeding territory. Breeding en route for males might be achieved by copulating opportunistically with early arriving shorter-distance migrant females, and for females via nest parasitism as observed in *C.u. undulata* (LESOBRE et al. 2010b), or via en route insemination that would fertilize eggs laid further north as female houbara have important sperm storage capacities (SAINT-JALME et al. 1994). Out of 218 return migration stopovers identified from satellite-tracked houbara,



Fig. 1. Asian Houbara Bustard *Chlamydotis macqueenii*.

38 met our criteria for the possibility of breeding en route, i.e., stopover of longer than five days taking place at a time when at least 50% of the local breeders of the opposite sex are already occupying their breeding territory. This concerned four Chinese males and 11 Kazakh and two Chinese females.

We conclude that substantial migratory connectivity, strong philopatry, and fidelity to breeding sites may not be sufficient to ensure strict genetic separation between populations. Incidental breeding en route and first year dispersal could play a role in disseminating genetic material between houbara populations in Asia.

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